# THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LIV.—No. 8. Whole No. 820. | NEW YORK, MONDAY, FEBRUARY 23, 1891. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

**Published** on each Monday of the year, at No. 42 Pine Street, N. Y.

**Terms of Subscription, Including Postage.**—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

**Remittances** should be made either by post-office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

**Collections** are invariably made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

**Correspondence.**—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

**The American News Company,** Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.


## CONTENTS.

An Asterisk (*) denotes an illustrated article.


EDITORIALS—
- Obituary—William H. Down..... 253
- The New England Meeting..... 254
- A Paternal Government and Our Industries, by Mr. J. R. Thomas, C.E..... 255
- Some Different Kinds of Gas Furnaces, by Mr. B. Dawson..... 255
- The Chicago International Exhibition of 1893, by Mr. Jas. Dredge. —Continued from page 225..... 257
- High-Power Photometry with a Bunsen's Photometer..... 260
- Twenty-First Annual Meeting of the New England Association of Gas Engineers—Official Report—Revised by the Secretary..... 260
  - First Day, Morning Session: Applications for Membership—Election of New Members—Report of Committee on Badges—A Tender of Sympathy to the Family of the Late W. H. Down—President's Address.
- ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 263
  - Annual Meeting, National Gas Light and Fuel Company—Bonding the New Bedford Company—Gas Power for Driving Electric Plants—Going Ahead at Elgin, Ills.—Annual Meeting, Kalden, Mass.—History of the Woonsocket (R. I.) Company—Some Ohio Gas Legislative Measures—Annual Meeting, Leominster, Mass.—A Fuel Plant for the American Tube and Iron Company—Mt. Holly's Electric Supply—The Milwaukee Company Does Not Object—New Hampshire Legislative Measures—More About Gas Power for Driving Dynamos—Annual Meeting, Helena, Montana—And Many Other Items.
- The Market for Gas Securities..... 265
- Obituary—Dr. N. A. Otto..... 266


## OBITUARY.—WILLIAM H. DOWN.

At an early hour, on the morning of Sunday, February 15, death brought release to William H. Down from the suffering that was his portion for the past six months. Not that during all the trying time did he murmur; but, in the temperate mood of his sunny nature, the days of tedium and the nights of expectancy were passed in resignation. It was feared by those who knew him best that danger was at hand when, in yielding to the loving demands of his family and to the advice of his physicians, Mr. Down consented to retire from active duty at the desk, in the old office that had known him for so many years. Always an active, alert business man, continued absence from his daily routine but strengthened the earlier fear that his case was serious; and so the sequel proved. The crowning earthly glory of a well-spent life is a peaceful death; and that came to him in full measure. On the Sabbath morning, with all that were dearest on earth to him near, he answered the summons that comes but once to any, but surely to be heard by all.

William H. Down was born in the city of New York, on the 9th of May, 1837, and was the son of Samuel Down, whose modest meter shop was known to the gas maker of 1835, even as its successor of to-day is known. Relatively there is no difference; for his father was a yeoman in the business as it stood almost, if not quite, 56 years ago. Certainly the gas maker's art of '91 is vastly better known and is vastly more imposing than was the case in '35, but the Down of our day was as much a man of his time and as well liked by his associates as was his father by his contemporaries. In fact, the history of the Down meter works would be almost a recapitulation of the growth of American gas industry, from its modest inception (1835) to the incorporation (1863) of the present Company, that resulted from the determination to unite certain New York and Philadelphia meter making interests. It is also thoroughly in keeping that a Down should still be in direct service of the Company, as the oldest son of deceased is in the harness now, thus showing three generations in unbroken line—something queer in this unrestful American age of ours.

Mr. William H. Down received a thorough education at the institution which is now known under the title of "The College of the City of New York," and all his inclinations were towards the gas industry. We first find him in the 18th street station of the Manhattan Gas Company, at the period when the elder Sabbaton—whose memory is still fondly cherished by those of the old line—was in charge. In due course of time a favorable opportunity (1865, we think) for promotion presented itself, which was availed of speedily, and this marked his appointment as Secretary and Superintendent of the Greenpoint Gas Light Company, which supplied gas to that section of the present city of Brooklyn, then bounded by Hunter's Point on the north and Williamsburgh on the south. In 1868 the proprietors of the Williamsburgh Company purchased the property and franchises of the Greenpoint Company, whereupon the latter works were dismantled, although the organization has been maintained. Declining a position in the Williamsburgh Company, Mr. Down entered the service of the American Meter Company, thoroughly perfecting himself in all the details of the business. In April, 1877, he was formally elected Secretary of the Company, which position he held at the time of his decease, as also did he retain the position of Trustee to the Company, to which post he was named in 1881. Of his services in these capacities it is quite unnecessary to comment; for few gas engineers in the country have not had, at one time or another, some sort of useful service from him—a service, too, that never was grudgingly given.

He was a pronounced advocate and staunch adherent of our Associations, and rarely did he miss a meeting of the New England, American or Western Associations, although perhaps his warmest allegiance was

to the first-named. The appreciation of him of the Mother Association may best be expressed by the beautifully sympathetic action taken by the members, whose opening meeting day came on the day set apart by his relatives for the last loving rites to their dead.

Mr. Down was elected to active membership in the American Association, at the ninth annual meeting (Boston, October, 1881), and although he does not figure on its records as a contributor of set papers, nor appear prominently in the discussions on those that have been read before it, nevertheless the Association is indebted to him for an enormous measure of important work through his services on committees, both regular and special. In illustration of this we have only to point to his admirable method of carrying on the delicate matter of harmonizing the meter industry of the country to a rational, uniform standard of meter unions. He was appointed Chairman of the Committee originally designated by the American Association—which Committee was also indorsed by the other Associations—to take over the seemingly chaotic task of arranging for uniformity in this respect; and we have always contended that the work of this Committee is a monument to the patience, tact and industry of those who carried it out to successful completion He was elected to Associate Membership in the Western Association, and no Eastern delegate was more warmly welcomed at its annual gatherings.

He was married in 1864, and all of his immediate family—wife, two sons and three daughters—survive. Heartily welcomed as deceased was wherever the dictates of duty, or the necessities of business, or the promptings of friendship called him, bringing to each as he did a wealth of honor, a store of perception, or a completeness of good fellowship, it was at home that he shone the most, was loved the best. Husband and father never had a better prototype; honest, loyal affection never a truer exponent. Home was his kingdom; wife and children were his lealest subjects. The harmony of his home life was the hall mark of the true man. This knowledge shall be their comfort when the sting of death is robbed of its sharpness by the merciful touch of memory.

The funeral services were celebrated at the late home of deceased, this city, on the morning of Wednesday last, the services being conducted by the Reverend Dr. Chamberlain, of St. Matthew's. The rites were chanted and sung (the St. Thomas Church quartette assisting) most impressively, amid an assembly of participants, many of whom journeyed hundreds of miles to join in the mournful farewell. Interment was made that afternoon in the quaintly beautiful Sleepy Hollow Cemetery, at Tarrytown, N. Y., where the Down family burial plot is located. At the grave, the full Masonic ritual was beautifully rendered, by a commanding representation from Normal Lodge, F. and A. M., 523, of which body deceased had been a prominent and painstaking member for more than a quarter of a century. Joining the Lodge in 1863, deceased served as Worshipful Master thereof in 1867-8-9, and again in 1886.

It is our privilege to say—having known deceased from his early boyhood, and watched his course from maturity to the end—that honor, capacity and steadfastness were the beacons that ever pointed his course.

## THE NEW ENGLAND MEETING.

The New England Association celebrated its 21st annual birthday in the usual hearty and valuable fashion, last week, and we must say that her increase in age—as Mr. Prichard properly said in his annual address, "it is the Mother of them all"—only brings additional charms to "her person." Boston, like New York, is not a thing of beauty in wet weather, particularly so when it comes to a matter of wet February weather, hence the damp day preceding the meeting presaged dripping discomfort, but a change came, and Wednesday was more than passable, after all. Boston, like the coquette she is, prinks up wonderfully under the sun, and Young's looked bright and lively enough when the gas men came trooping in. Perhaps 100 members paid respectful attention to Chairman Prichard's announcement that the Association was legally 21 years of age, and from that on not many idle moments were indulged in. The same Prichard makes an excellent presiding officer, always saying the right thing at the right time, and keeping the guiding reins always taut. The visiting delegation was not notable in numbers the first day, but later on the cause—and a deeply deplored one it was—was shown plainly enough. The funeral services over W. H. Down, whose burial was named for Wednesday, kept many away. Nor did the Association as a body disremember the sad fact that their oft-time welcome guest was at peace with the world. Its action in regard to his demise was spontaneous and appropriate, but as our other columns contain the official account thereof, it would seem most fitting to point silently thereto. Quite a goodly addition to the membership list was secured, and following the report of the Committee on Badges, as also the Down memorial action, President Prichard delivered his inaugural, which also will be found *in extenso* in our current issue. His message is in all respects an admirable paper, and shows him in his true light as an observant, logical man, whose ready reasoning finds an easy outlet in language that cannot be distorted without exposing too plainly to view the mangling of his opinions. As the editorial space in this issue is not sufficient to allow us to say all that we wish in respect to several of its important points we defer extended comment on it for a week, rather than slight them now. We shall, too, in common with our readers, have a better understanding of it then. The papers read were direct, entertaining and instructive, and the discussions were pointed and instructive. Indeed we are not sure that this is sufficient praise of them. And this leads us to the election of officers, in respect to which there was a surprise in store for the Association. The gentlemen selected were:

*President*—H. A. Allyn.
*First Vice-President*—W. A. Wood.
*Second Vice-President*—C. H. Nettleton.
*Secretary and Treasurer*—C. F. Prichard.
*Directors*—E. C. Jones, Z. M. Jencks, F. W. Norton, E. C. Learned, S. J. Fowler.

There was no help for it. Mr. Nettleton would not serve any longer. His home business and his assumption of the duties of the Presidency of the American Gas Company were such as to preclude his acceptance of the Secretary's position. He, however, has the knowledge that as Secretary and Treasurer of the old New England Association he has done every credit to its interests, and has proved his regard for the honor and labor so often put upon him. Ever conscientious and capable, his record is the testimony of his worth and value. Perhaps no better man could have been chosen to succeed him than Mr. Prichard, and the latter's action, in accepting the position, the labor and perplexities incident to which are fully comprehended by him, is noteworthy evidence of the spirit that animates—that always animated—the members of the New England Association. Mr. Prichard has served the Association as its Chief Executive, but, listening to the unanimous invitation of his fellow members, who discerned his especial fitness for the place, he puts aside personal inclinations and again dons the harness. We congratulate Mr. Nettleton on his successor, the Association in its good fortune, and Mr. Prichard on his unselfishness.

To go back a trifle, to the membership and the papers. The Association added to the Honorary Roll two more names. In respect to the first of these—Mr. W. W. Greenough, of Boston—we have only to remark that this mark of recognition is heartly welcomed; for who in New England has stronger claims on the respect and good-will of the gas fraternity of the Eastern States, or for the matter of that the country over, than Mr. Greenough, Sr. Tardy though the formal recognition be—and beyond doubt Honorary Membership in any of our Gas Associations is the true seal of approbation of one's fellows—all will hail it with acclaim as having been worthily bestowed. New York also secured a similar appointment in respect to the elevation of our brilliant townsman, Capt. W. Henry White. The delegation of visitors on the second day was numerically strong and solidly representative—some Western faces beaming prominently, not the least jovial of these being carried by the man from Toledo.

An additional paper came to hand, from the elder Mr. Gerould, who wrote about unaccounted-for gas in coal gas works, and then, having given the cause, set out a remedy and the results thereof. The question box held some puzzling queries, but they could not "stump" the members. In fact, this part of the proceedings was quite up to any other of the set numbers on the programme.

The banquet was a most enjoyable affair. There was about it that happy blending of stiffness and unbending, of formal courtesy and jovial greeting, that should give ease to the puritanically inclined and comfort to the hale-fellow—possibly an instance of extremes meeting, to be reconciled without effort.

Thursday afternoon was devoted to an inspection of a display of apparatus and fixtures at the rooms of the Gas Appliance Exchange, the showing being a very creditable one indeed. An elegant lunch was provided by the manager. At 2 P.M., the train for Lynn was taken, for the purpose of visiting and inspecting the Thomson-Houston Company's factories in that city, which opportunity was accorded through invitation from Mr. Robert B. Taber. Immense, complete, was the verdict rendered when the inspection was finished; but all the din and bustle failed to fluster the New England gas makers, who are more concerned over works' extension just now than about anything else outside or inside the pale of artificial lighting possibilities.

[A paper read before the Society of Gas Lighting.]

## A Paternal Government and Our Industries.

By Joseph R. Thomas.

Much has been said and more written with reference to National, State and municipal control of our various industries; but the subject we wish more particularly to bring forward in this paper is with regard to the municipal ownership of gas and other lighting plants. One of the latest documents upon this subject was formulated at a meeting of the Economic Association, held in the city of Washington, D. C. At that meeting one of the professors on economic matters, in his paper read before the Association, lays down a hard and fast rule of just what a lighting plant should cost, and the precise amount in which the same ought to be capitalized, and that any divergence from this rule, or as to the sum used for the purpose in the erection of a plant in excess of the figures given by him, ought to be considered as only so much water added to the capital account, and, therefore, treated accordingly.

There are many professors of economy, or, we might say, economical professors, who, when any subject matter is brought forward for discussion, assume at once to know it all, and that their *ipse dixit* expressed on the subject must in no wise be questioned. Their actions remind us vividly of the old saw going to show that when anything is to be done a woman always wants to find out just what it is, and that impulse is at once followed by her wish to boss the job. Indeed, it cannot be doubted that, under most circumstances and conditions, the woman would act quite as intelligently, if not even a little more so, than many professors of economy would be able to do under the ruling circumstances. It is generally followed out, in the installation of a gas plant, that its present need and requirements are taken into consideration, and a fair allowance made for the future progress expected to be attained in the business as time goes by and improvements develop in the territory the company is about to supply with the commodity that its projectors are preparing to distribute as an illuminant. The following of such course necessarily entails a larger outlay of money at the beginning than would be the case were the quantity of gas to be furnished a fixed factor. Thus it will be evident that the capital employed in the undertaking must of necessity be largely in excess of what it otherwise would be were the plant erected with a view of being only equal to furnishing a supply of gas to meet present requirements, without allowance for future development. To exemplify this: A plant might be erected to furnish for present needs a daily output of gas of, say, 20,000 cubic feet, but with every facility in connection therewith so that, with a reasonable additional outlay, the sendout could be increased to, say, 100,000 cubic feet in the 24 hours. The capital represented would then, of course, be greater than were the plant just calculated to furnish the lesser quantity. The extra expenditure, however, would be in the line of true economy in every way, although the capital represented at the beginning of operations would be much greater per 1,000 feet of gas manufactured than it otherwise would be were the penny wise and pound foolish system adopted of merely providing for the present actual requirements of the company.

The business of gas manufacturing has been (and still continues to be) a growing one, and in its present healthy condition bids fair to continue in the same line. From this fact a plant ample to furnish all the gas that may be required at present may, in a very short time, be unable to meet the increasing demand made upon it, in which event the only course left must be to provide the facilities for manufacture to meet the increased business. This procedure will cost money to accomplish, and so add additional capital to that already employed in the business. A plant calculated for a daily output of 100,000 cubic feet of gas cannot supply 200,000 cubic feet in the same time; so, like a boy in his progress from early youth to manhood, the gas company, becoming too large for its infant installment, is compelled to branch out and increase its plant, to meet the circumstances under which its growing business has placed it. In the boy's case, his garments may be let out here, or added to there; but this can only be a temporary expedient, for eventually he will have to be provided with new clothing, entailing additional expense, and adding to the capital already invested in him. In like manner, when the business of a gas company has outgrown its capacity for supply, nothing else can be done to provide for the emergency than to furnish additional plant, which can only be accomplished by an additional outlay of money, the increase naturally going to swell the capital already employed.

Some of our economists may say, why not, in the first place, have made the plant ample for all future contingencies and demands that would be made upon it? This way would have prevented the necessity of increasing the plant for all time, but at the same time it would not have been a sensible course to have followed, as the extra capital employed would have been very much out of proportion at the commencement of the business, and have remained so until the plant could have been fully utilized. The amount of capital employed per thousand feet of gas manufactured is, in many instances, as much a matter of good luck as it is of good judgment, and depends entirely upon the rapidity with which changes in the manufacturing plant have to be made. Where a company is working along comfortably, and slowly approaching its maximum capacity, little outlay on the plant is required; whereas, upon the other hand, a company making rapid strides in its business is necessitated to make improvements to meet the increased business, and in so doing may be compelled to abandon the old plant and erect an entirely new one. Although this will increase the amount of capital employed per thousand feet of gas manufactured, at the same time it must be done to keep pace with the increased business of the company.

The tendency of the age is to regulate everything for us, poor mortals that we are. Some professor will inform us just what we should eat, and when we should eat it; how we ought to sleep—whether it will be best to do so with our heads to the east or to the west, or if nature's sweet restorer can best be obtained in a horizontal position, or whether we should seek it on the perpendicular plan, with head up or head down, as the emergency may require. Were we to follow out only part of the advice thus furnished we would soon be reposing where wicked professors cease from troubling and the weary rest.

Of course, there are numbers of people who cannot or will not care for themselves, and so are always looking out for someone to undertake the task, by seeking every available chance to secure that which, in common parlance, is termed *a soft snap*—little to do and big pay for the doing of it. This class of people, if not blessed with a generous godfather, turn their attention to the forming of a paternal government, who, they claim, ought to own all our railroads, telegraph lines, and other industries as well. Then they would be furnished with free travel, free messages, free food, and free homes—the expenses thereof all to be paid out of the large profits obtained from the great business engendered by this system! Should the general governmental paternal system fail to materialize, then their attention is directed to the State governments, who, they say, and say truly, are now caring for the insane, the paupers, and also the vicious. To a great extent, then, why not care for all? But the great desideratum and the salve required for all the ills that human flesh is heir to, they imagine can only be obtained through our municipal corporations. They point to our police of the finest, saying, look at them; see how well they are provided for. Also the police justices, with little to do and tremendous salaries for the doing of it; or the aldermen, many of whom, when first inducted into office, resembled Pharaoh's lean kine, but who, having been there awhile, getting in on the ground floor at a combine or two, fatten up like stuffed pigs in a prize show, all brought about by feeding at the public crib. So, seeing all these things, they wish to get into the ring, and if there are not positions enough to go round, the only other thing to do is to make more of them—through municipal control of our industries.

However, we have yet to learn of any business carried on by our municipal corporations that is conducted as economically as the same could be performed by a private corporation. Nor is this a matter of surprise, when we take into consideration the material strongly represented in the employees of our municipal bodies. In this latitude men of mark, fully competent, energetic, and possessed of sterling honesty, are seldom found among corporate employees. Their fitness for the positions counts for nothing as against others who have what is termed a political pull, although there may be instances where the reverse of this is the case. These latter instances are only the exceptions and not the rule in any manner. So, were we depending on municipal corporations in general to help us out of our troubles, we would fail sadly, and very likely get out of the frying pan only to find ourselves in the fire.

## Some Different Kinds of Gas Furnaces.

[A paper read by Mr. Bernard Dawson before the annual meeting of the London Institution of Mechanical Engineers.]

The greater number of gas furnaces in which crude heating gas has been successfully applied have been of the kind now universally known as reversing regenerative furnaces. There are many processes, however—requiring various degrees of temperature below that which can be maintained with any regularity by the use of regenerators only of the kind associated with the name of Sir William Siemens—in which gas furnaces have been used with some degree of success, both as regards economy in quantity and quality of fuel consumed to do a given quantity of work, and also as regards increased speed of work, saving in wear or destruction of the furnaces themselves, saving in labor, abolition of

smoke, and the certainty of being able to maintain an atmosphere or flame either of a reducing or of an oxidizing nature; the two latter being essential conditions in many manufacturing processes. In large works it is often a further great advantage to be able to concentrate in one place the manipulation of all the fuel required in the various furnaces scattered throughout the different departments or shops, as also to avoid the nuisance arising from having to clean the fires and to remove the ashes. It is therefore at times a distinct advantage to employ gas for heating furnaces in which the saving in cost of fuel is itself a secondary or comparatively unimportant matter. The exact point at which it is advantageous to dispense with the somewhat costly system of reversing regenerative chambers is one on which there is some diversity of opinion. There are, of course, many furnaces, which can be and are being heated by gas, in which the temperature required is not high enough to render reversing regeneration either economical or even advisable. It is probable, however, that the many comparatively low temperature gas furnaces, to which such regeneration has been successfully applied at the new locomotive works of the Lancashire and Yorkshire Railway at Horwich, may lead to this form of furnace being more generally adopted in future for such work as annealing steel castings, heating plates and angle bars for locomotive and marine boiler work, and for shipyards, where a uniform temperature all over a large plate is required for flanging or bending. On the other hand, there are many furnaces in which the higher temperature required is such as cannot be attained by the combustion of producer gas with cold air, but in which, with air heated in flues by radiation or conduction from the bed of the furnace and from the flues leading from the furnace to the chimney, a satisfactory result is attained, with some saving in first cost in building the furnace, and without the necessity for much excavation below the bed or hearth of the furnace. The use of gas with cold air is necessarily wasteful, owing to the inability to recover the waste heat from the flame or products of combustion before they pass away to the chimney; and this waste may be prevented by the employment of what may be termed continuous, as opposed to reversing, regeneration. In furnaces of this kind, as also those with reversing regeneration, care must be taken to ensure that the escaping gases or waste heat shall pass into the chimney flues at a sufficiently high temperature to secure the amount of draught requisite for working the furnace advantageously. Unfortunately designs for gas furnaces of different kinds, both regenerative and non-regenerative, and with various forms of continuous regeneration, have been proposed to manufacturers, and carried out by them in ignorance of the true principles of combustion of gaseous fuel; and the author has known some egregious and costly failures with experimental and untried furnaces for various special processes during the last 10 or 11 years that he has been engaged in this class of work. Some of these furnaces, by attention to the bad results attained and study of the causes, have ultimately been made to succeed. Others, either from inability to rectify them or from disinclination of their users to spend money upon further trials, have been abandoned. In many cases where the level of the land on which the furnaces are built, the presence of water below the ground line, and other local circumstances, preclude the use of underground reversing regenerators, continuous regeneration has been successfully adopted.

Gas furnaces may properly be divided into four classes—(*a*) with reversing regeneration; (*b*) with continuous regeneration; (*c*) non-regenerative; and (*d*) with blow-pipe or forced blast. (*a*) Furnaces with reversing regeneration are of several different kinds: (1) The ordinary Siemens furnace, in which both gas and air are heated before admission to the interior of the furnace, by being passed through the well-known arrangement of brick chambers filled with chequer-work or loosely piled bricks. (2) The Batho or Hilton furnace, in which the regenerative chambers, instead of being partly or entirely underground, are encased in cylindrical wrought iron vessels erected upon the ground level. (3) Furnaces in which the air only is regenerated by being passed through chambers; the gas being admitted direct from the flues by which it arrives from the producers. In these furnaces the whole of the escaping gases or waste heat has to pass through one of the two air chambers on its way to the chimney. (4) The furnace described by Mr. Head before the Iron and Steel Institute at their 1889 meeting, in which a portion of the waste heat is taken back to the gas producer. (5) The various regenerative blast-furnace stoves of the Cowper, Whitwell, and other kinds. (*b*) In furnaces with continuous regeneration, the air, before admission to the interior of the furnace, is heated in flues or pipes, by radiation or conduction from the bottom of the furnace, and through thin walls which separate the air flues from the flues that carry the spent gases or waste heat to the chimney. (*c*) In non-regenerative furnaces the air is admitted to the interior of the furnace at its natural or atmospheric temperature. (*d*) Blow-pipe or forced-blast furnaces are of two kinds—Firstly, those in which the air is supplied at its natural or atmospheric temperature by a fan or blower; secondly, those in which the air so supplied is heated by the spent gases or waste heat from the furnace, by being passed either through coils or stacks of pipes, or else through brick tubes or flues, as with the Radcliffe furnace and others.

Furnaces with reversing regenerators for both air and gas have been built principally for such high temperatures as are required for melting steel, copper, nickel, zinc, and glass; for heating iron piles and steel ingots; for forging furnaces, and heating furnaces in connection with stamping and flanging presses; for tire furnaces, tube welding, heating gas works retorts, burning pottery and bricks, and so forth. Continuous regeneration furnaces are used for muffles, low temperature annealers, furnaces for close and open annealing of sheet iron and tin plates, of brass and copper tubes, cartridge cases, and wire. Non-regenerative furnaces are used for such low temperatures as are employed for evaporating brine, for boiling and distilling oil and tar, brewing pale ale, drying slurry in cement works, drying foundry cores and moulds, revivifying charcoal in sugar works, and burning carbon for electric light purposes. Also for firing steam boilers of all kinds; for heating revolving and other furnaces at chemical works, black-ash and sulphate of soda furnaces; for evaporating waste leys and clack liquor in paper mills; for roasting and calcining ores; and for many other industrial purposes too numerous to recapitulate. Blow-pipe furnaces, into which heated air required for combustion is delivered under pressure, have been used for puddling iron, melting brass in pots, heating plates for stamping into railway sleepers, melting zinc ores, welding tubes, etc. But with the exception of some few puddling furnaces on the Continent, the author believes that this application of producer gas has not yet been carried to a success.

The failure of some non-regenerative furnaces may be attributed to losing sight of the different specific gravities of hot producer gas and cold air; and also to neglecting to impart to the air, before it meets and mixes with the gas, some impetus or motion in the same direction in which the gas is traveling on its entrance into the furnace. For instance, where cold air is admitted in a horizontal stream over the gas which is rising vertically or obliquely from the gas valve, intimate mixture and perfect combustion are rarely attained; in addition to which, small explosions and other troubles are frequently experienced. In other cases the introduction of the gas and cold air into the furnace in parallel streams, or in any large volumes, either side by side or over one another, has led to failure. In furnaces to be heated by gas and cold air, either the volume of each should be split up into a number of small streams by perforations in the walls forming the inlet to the furnace; or else some form of combustion chamber should be provided, in which the gas and air can be mixed and partially ignited before admission into the actual furnace itself. The regulation of the pull or draught of the chimney on the furnace—so as to draw in just sufficient cold air for burning the gas, without drawing unburnt gas into the chimney—although often neglected by the furnace men, can easily be effected with a little care, provided that the respective sectional areas of the gas and air inlets and of the outlet to the chimney have been duly considered in building the furnace.

The principles and construction of furnaces with reversing regenerators for both gas and air are now much better and more generally understood than was the case only a few years ago. It is curious, however, to what a small extent gas crucible furnaces have been substituted for the old furnaces, or "coke holes," in which the greater part of the crucible steel melted in Sheffield is still made. The many objections heard from time to time, as to inability to keep a mellow heat or regulate the heat and the draught, are such as can certainly be overcome. There may, however, be other objections and difficulties, with which only those actually engaged in steel melting are acquainted. With so many different means of attaining and regulating the temperature in gas furnaces, and with such perfect control over the admission of gas and air over the chimney draught, there are few industrial processes requiring heat to which producer gas ought not to be capable of being advantageously applied. The question of extra first cost in the erection of new furnaces, and the impossibility of applying gas to existing coal-fired furnaces with any degree of success, have very much prevented the extension of gas-firing; although the erroneous ideas prevalent as to the necessarily complicated nature of gas furnaces, and as to the cost of repairs and maintenance, have probably done quite as much to prevent many such furnaces from being built. An objection had been raised that, whereas with a coal-fired furnace the furnace men attend to the fire themselves, with a gas-fired furnace they would not or could not attend also to the gas producer, which thus entails an extra man. This question of extra labor has not unnaturally been brought forward in connection with various combinations of gas producers and furnaces, as showing the ad-

vantage of having the producer attached to its own furnace. The disadvantages of this plan appear to be that, whenever from any reason a furnace has to be stopped, the gas producer connected with it must stand too—representing so much idle capital, and therefore a greater total expenditure in producers than where, say, a dozen producers are erected all together to supply a number of furnaces of which only a certain proportion are ever at work at the same time. The necessity of having to convey fuel and ashes to and from several furnaces in large works is also a disadvantage in the plan of combined producer and furnace. The loss of heat by radiation in the passage of the gas from the producers to the furnaces is sometimes adduced as an argument in favor of the combined plan; but with properly constructed flues this is more imaginary than real. Reversing regenerative furnaces are now largely used for melting glass; and in tube works, furnaces with reversing regeneration are used for welding iron tubes for water and gas and steam, although the use of gas furnaces has not at present extended beyond a few of the largest works.

The application of jets of water gas to welding large tubes, boiler flues, seams of sugar pans, etc., at the Leeds Forge, and at Messrs. Thomas Piggott & Sons' works at Birmingham, and Messrs. John Brown & Co.'s works at Sheffield, can scarcely be accurately regarded as constituting distinctive furnaces, and therefore admit of no more than passing mention. But Mr. Oakman, the European representative of Mr. B. Loomis, has recently applied water gas, made by this process from small coal, to a crucible-steel furnace, to a furnace for baking clay crucibles, to an annealing furnace for tubes, and to another for tube welding at Messrs. Howell's works in Sheffield. Arrangements are made by which these furnaces can be supplied either entirely with the producer or "bye" gas from the water gas plant, or with a mixture of this "bye" gas and water gas, the proportions of each being regulated by valves at will. It is to be hoped that before long some information will be furnished as to the comparative cost of fuel and labor, also as to the time saved and the increased output attained by the use of mixed gases, so that the expediency of erecting water gas plant, in order to make and store two gases separately, and then mix them again before use, may be definitely settled. It is beyond doubt that there are many purposes—such as tube welding, heating bolt and rivet iron, chain welding and other processes requiring a high local temperature concentrated upon a small surface or upon a small portion only of a large surface—to which ordinary producer gas has never been advantageously applied, and for which pure water gas appears to be very suitable. The Loomis water gas plant erected by Messrs. Howell is stated by them to be working to their entire satisfaction, and with economy and regularity. Some of these furnaces have continuous regeneration, and others reversing, of the air alone in every case. Similar furnaces are now being erected for making wrought iron wheels, and for melting steel and glass, to be worked by water gas made from coke, on the principle that is in use, as above mentioned, at the Leeds Forge.

Retorts for making illuminating gas in gas works have been heated by producer gas made both from small coal and from the coke raked out from the retorts themselves, and have been arranged both with continuous regeneration and reversing regeneration of the air, but have never been extensively adopted. Descriptions of such furnaces have been given by Mr. Foulis, of Glasgow; Mr. Charles Hunt, of Birmingham; Mr. Denny Lane, of Cork, and others. The Klonne and other systems of combined furnaces and gas producers have also been introduced in many large gas works with success. But to describe them in this paper fully would take too much time and space. A large number of gas furnaces, principally on a small scale, and applicable to a great variety of purposes, have been invented by Mr. Fletcher, of Warrington; but as far as the author knows, they have been confined to the use of ordinary illuminating gas. There are few industries requiring the intelligent use of purified gas which are not indebted to the patient investigations and experiments of Mr. Fletcher. Mr. Emerson Dowson's various applications of heating gas deserve recognition; and it is to be hoped that at some future date the various types of small gas furnaces, to which these truly belong, will be treated of. In the chemical industries a variety of gas furnaces have been introduced, and the author believes that before many years have passed the rising price of fuel must increase the number of chemical and alkali works in which the use of gaseous fuel will have superseded the employment of solid smoke-making coal.

---

THE Eureka (Kansas) Light and Ice Company has been incorporated by Messrs. H. J. Jones, J. E. Evans, Jas. Strultz, M. Edwards and A. S. Pettit. Capitalized in $30,000. This place is the capital of Greenwood county, and is located at a point on Fall River about 48 miles south of Emporia. Population, about 5,800.

[Continued from page 225.]

## The Chicago International Exhibition of 1893.

[A paper read by Mr. James Dredge, of *Engineering*, before the British Society of Arts.]

The history of Chicago begins in 1811, when the site was occupied by military outposts in constant peril from hostile Indians; and until 1831, by which time life and property had become more secure, it possessed only a few inhabitants isolated from the rest of the world. In February, 1835, the place was incorporated as a town, and two years latter it was raised to the dignity of a city, with a population of about 5,000. From that time to the present, the municipal area has been extended seven times; in 1847 and in 1853; then 10 years later, and again in 1869, in 1887, in April and in July, 1889. The last annexation of territory was on a heroic scale; previously the area was 44 square miles, but by a vote of the people recorded on June 29th, 1889, the limits were at once extended to include 128.24 square miles additional land, and the great metropolis was by this act endowed with a sudden increase in the population of over 150,000 people. At the present time the city extends north and south for a distance of 24 miles, while from east to west it has a width that varies from 4.5 to 10.5 miles. Probably, so sudden and great an increase in a city is without a parallel; and the most peculiar feature of the consolidation is, that it appears to have been effected without any serious opposition, although by the change six independent municipal corporations, with all their legislative and executive powers, were absorbed, and their separate dignities and responsibilities swept away. It is of course this system of annexation that has contributed largely to the phenomenal growth of the city; but the fact remains that such a growth would have been impossible if the increase in trade and industry had not been equally phenomenal, and this increase would have been unattainable but for the vast development of the adjoining States, the trade from which naturally gravitates to Chicago as the center.

Of the extent and future possibility of the States lying to the west of the Mississippi—and the development of which greatly affects the trade of Chicago—we can form but a very limited idea. The area on the west of the great river is twice as large as that which lies on the east, and of this what is not mineral land is, for the most part, richly adapted for agricultural and pastoral pursuits. The proportions of the Western States are almost beyond one's grasp. Texas could hold the whole population of the United States, and not be more crowded than Germany. Dakota could do the same, and so could New Mexico. The State of Texas alone could produce nearly all the food crops required for the entire country. It could raise more than all the cotton crops, and pasture lands as large as the State of New York would still remain. It is estimated that the arable lands of the West cover at least 900,000 square miles. There are 260,000 square miles of timber country; and, in 1880, less than one-fourth of the pasture was occupied with more than 61,000,000 of live stock. It would seem as if the future destines of the United States must be controlled from the West, the population of which, by natural increase and by immigration, is growing with so much rapidity; where energy appears unbounded, and the wealth of the soil, as of riches hidden beneath its surface, is inexhaustible. A well-known American writer says: "The unrivalled resources of the West, together with the unequalled enterprise of her citizens, are a sure prophecy of superior wealth. Already have some of the young States outstripped her elder sisters of the East in individual wealth. * * * The West is destined to surpass in agriculture, stock raising, mining, and eventually in manufacturing. * * * Beyond a peradventure the West is to dominate the East. With more than twice the room and resources of the East, the West will have probably twice the population and wealth of the East, together with the superior power and influence which under popular government accompany them."*

These sentences, written some years ago, would seem to be already partially confirmed, and if the forecast be too sanguine and enthusiastic, the conviction is nevertheless forced upon the foreign visitor that if the head of the nation lies upon the Atlantic shore, the heart beats in the Middle States, and the sinews and muscles are in the West. Certain it is that some such process of western domination as that described in the lines above quoted is now in progress, and when the mighty struggle comes, as come it must, and that possibly in no very distant future, between protection and free trade, it is in the West that the anti-tariff banners will be unfurled.

To give an idea of Chicago as a great trading metropolis, it is necessary to have recourse again to figures. The city is the converging point for 30,000 miles of railroads, and it is claimed that 81,000 miles, or nearly

* "Our Country," by the Rev. J. Strong.

half the total network of railways that cover the United States, affect her commerce more or less directly. She is the main center of the vast trade carried on upon the chain of inland seas which gives her a direct water way to the Atlantic, and places her, if not on a level with, at least only second to, New York as an American port. To her stock yards are brought a daily average of 30,000 head of stock, and with the exception of what is required for consumption in the city, is exported in various forms.

Hogs and cattle, with their various products, grain and ore, form the staple of trade in Chicago, but besides these there are a vast number of imported industries that give employment to about 150,000 workmen; the number of miscellaneous manufactories in the city is about 25,000. During the year 1889 there was received in the city elevators, or on the wharves, 183.5 million bushels of grain and its equivalent in flour; this represents more than $\frac{1}{20}$th of all the grain raised in the United States.

The estimated value of the live stock received at Chicago last year exceeded £40,000,000, and nearly 5,000,000 tons of coal were delivered in 1889, and 650,000 tons were shipped: most of this was brought from the coal fields of Illinois, Indiana and Ohio.

The steel works of Chicago are sufficiently important to produce a greater tonnage of rails than any other steel center in the country; in this industry, as in so many others, the position of the city is extremely advantageous, ore being delivered to the works for a freight of only 60 cents per ton, and the rates for coal are also very moderate; the ores chiefly used average about 60 per cent. of iron. With such a large grain trade, storage accommodation on a corresponding scale is a necessity; all, or nearly all that is brought to the city has to be deposited in the elevators for subsequent transshipment into vessels, railway wagons, or into carts for local requirements. There are altogether some 30 elevators of the first magnitude, the combined capacity of which is 30,000,000 bushels. The largest of these great stores contains 3,000,000 bushels, but the average capacity is less than half this amount.

While it is difficult to obtain figures as to the total tonnage of through freight that arrives at, or is despatched from Chicago, it may be interesting to note that at least 3,000,000 tons represent the bulk of the traffic passed through the city from various places for consignment without breaking bulk, which is more than 6,000 tons per day.

The lake navigation is, however, the most interesting portion of the transport trade of Chicago, and on this subject very detailed statistics are compiled. The harbor, as well as the whole of Lake Michigan, is placed under the charge of the United States Engineer Department, and, for a number of years, works of more or less importance have been carried on to increase the facilities for shipping and to give relief to the overcrowded river. The outer harbor has an area of 450 acres, about 100 of which are reserved for the future construction of docks and wharves, by reclaiming the foreshore and filling up for for a width of some thousand feet, parallel to the existing bank. Outside, the harbor is inclosed by easterly and westerly breakwaters, as well as by a northern pier, all of timber, but it is intended to replace these by stone and concrete. Since the works were commenced, $1,500,000 have been expended on them, and the outer harbor has been dredged to a depth of 16 feet.

The lake navigation is open from the end of April to the beginning of December, so that only 7 months are available in the year, although a small number of coasting vessels feel their way along the shore of the lake in spite of the dangers from ice. In the year 1870 there were 12,739 vessels arrived, and 12,433 cleared at the port of Chicago, the total tonnage being about 5,000,000. In 1889 the number of vessels entering the port was 10,804, and that leaving 10,984, while the respective tonnage was 5,102,790 and 5,165,041. Besides the increase in trade, which has doubled during the last 20 years, it will be noticed that the larger tonnage was carried in 2,000 less vessels than in 1870, showing an increase in the size of the ships used, which now rises as high as 3,000 tons. It is, of course, to be expected that the lake trade should increase at a very rapid rate, because the freight charges by steamer can always compete successfully with those by rail transit, and thus give to such systems as the Erie Railroad special advantages, because over the greater part of the distance—that between Chicago and Buffalo—goods are conveyed by water.

Chicago possesses but few attractions to the general European visitor; it is a city of perpetual noise and bustle, where the constant roar of traffic and the ever-crowded streets banish all idea of repose. The longest day appears too short for its appointed work, and the whole object of life seems concentrated in the desire to shorten it by wearing it out. The increasing manufactures and population threaten Chicago with the same pall of smoke that rendered Pittsburgh a bye-word till within the last few years, and as it is not probable that natural gas will be found in the vicinity, the problem of smoke consumption is even now one of formidable proportions.

Chicago is laid out with main streets or avenues after the fashion of most American cities, with narrower streets crossing, generally at right angles—a geometrical arrangement that possesses many advantages. The rule has of course many exceptions, rendered necessary in some cases by the intrusion of the sluggish Chicago river and its branches. The streets and avenues are wide, and on a dead level; the principal ones are bordered by vast piles of buildings which are the glory of the citizens and the wonder of visitors. Although the town has an area of 174 square miles, the prices of land in the central portion rise to fabulous amounts, and rents are dearer than in London; for this reason, and with a desire to possess the highest buildings in the United States, the blocks are run up to 12, 13, and even 15 stories in height. In some of these, staircases are regarded as superfluous, and in all of them, elevators, sometimes as many as 8 or 10, run up and down all day at express speed. Street railroads, of course, form the chief means of transit for passengers, and it is in Chicago that the cable system of tramways has found its fullest development. The high speed at which the cars are propelled by this means is counteracted to a considerable extent by the heavy wagon traffic that crowds the ill-paved streets. The concentration of business is naturally greatest upon the branches of the Chicago river and the 35 miles of wharves that constitute the accommodation of the port. The streets crossing the muddy stream and its branches are connected by swing bridges, the constant opening of which, for the passage of ships, causes a continual congestion of traffic. This is avoided in some instances by the construction of tunnels underneath the river. Seven terminal stations, that provide for 21 different railway companies, add to the busy aspect of the city, and the great network of competing lines that concentrate over the suburbs, crossing and recrossing each other on the level, give the visitor a high respect for the superior intelligence of the American engine driver, who, assisted with only a very crude signal system, contrives to handle an enormous train business with but few accidents and little loss of life. Except for theaters and parks, Chicago may be said to have no means of amusement, for which, indeed, there seems no leisure. Possible visitors to the Columbian Exhibition of the idle class may take this information as a hint that they had better stay away. Besides the vast business blocks of the city, and the Auditorium buildings, which contain a giant hotel, the largest theater in the world, hundreds of offices, scores of shops, and a Government signal station, the pride of the inhabitants lies in their parks and the suburban dwellings of the wealthy inhabitants, who must be very numerous, if a conclusion can be drawn from the number and appearance of these residences.

A struggle scarcely less severe than that at Washington followed the victory scored by Chicago, and took place within the city itself. This was the battle of the sites, in which all citizens, and many who were not interested at all, took part with that energy and vehemence so surprising to an Englishman. Railway Companies and Park Commissioners, the Government Committee and the local executive, even the United States Engineering Corps, took active sides in the dispute, while the Chicago newspapers, with but little patriotism and less reason, added to the confusion by indiscriminate condemnation. Of course order was evolved out of all this chaos, but not until much valuable time was lost, and more or less mischief done. One of the most lively causes of dispute was the so-called dual site that involved the arrangement of the Exhibition in two localities about three miles apart. Without explanation, this proposal appeared an unpractical one, though in reality it was attended with many advantages, and was in the end very willingly adopted.

Another matter of discussion was as to which of the parks in Chicago should be selected for the construction of the main buildings. Many such parks were more or less well adapted for the purpose, and each site, as it was proposed, found a large number of enthusiastic supporters and an equal number of determined opponents. A large space of land was offered for the purpose by a private owner, and an extensive site close to Lake Calumet was also suggested. Both these latter proposals were, however, soon abandoned, because, though the ground in each case stood within the city limits, they were too remote to be practicable. In the end, a decision was made in favor of Jackson Park, a large and partly reclaimed space of about 800 acres, situated on the Lake front, and in the southern part of the city. But it was felt that the space thus given by the South Park Commissioners was insufficient for the purposes of the Exhibition, and efforts were made to secure the smaller and very beautiful Washington Park, lying at some distance away. After many negotiations a satisfactory arrangement was entered into between the Park Commissioners and the Exhibition executive, by which both

Washington and Jackson Parks were ceded, as well as a broad connecting strip known as the Midway Plaisaunce, which connects the two parks. By this arrangement an area of some 1,200 acres was secured for Exhibition purposes, an extent felt to be amply sufficient, if not embarrassingly large. At the same time that this arrangement was completed, the difficulties that had existed between the executive on the one hand and the Illinois Central Railway Company and the United States Engineers Department on the other were satisfactorily adjusted. These difficulties had their origin in the demand of the executive for the cession of a piece of ground on the lake front, situated in Lake Park, in the central part of the city, and an addition to this space by a reclamation of a portion of the adjacent foreshore. The total amount thus obtained would equal about 80 acres, and was required by the executive for the erection of special buildings. It was this independent space, three miles from Jackson and Washington Parks, which constituted the much debated dual site. But the railway company threatened injunction on the ground of trespass, and the Government Harbor Board forbade the filling up of any portion of the lake, which is national property; so that for a long time it appeared as if the projects of the executive concerning the dual site would have to be abandoned. In the end, however, amicable compromise overcame the various obstacles, and the executive became possessed of the land, and of the power to extend it into the lake, under very favorable conditions.

It forms an important part of the Exhibition scheme to utilize this park lake site for the construction of large and possibly of permanent buildings for the display of pictures, and probably for collective exhibits of scientific rather than of commercial interest. It is intended also to add to these as many attractions for the public as can be devised, and that this part of the Exhibition at least shall be kept open at night, for the benefit of visitors staying in Chicago, and who may not feel disposed in the evening to go so far as the main Exhibition buildings. The common sense of this proposal will be apparent when it is remembered that Chicago, like all other American cities, is deficient in public amusements and attractions; and it is thought by the Exhibition executive that it would be possible to create special attractions for the public in this small area similar to those that were so successful in our series of exhibitions at South Kensington—the first condition of success being the creation of serious exhibits to serve as an excuse for attending out-of-door amusements.

Having secured the two large parks of Washington and Jackson, with a connecting strip, the next important question that presented itself was in which of these parks the main buildings should be erected. Washington Park presents the advantage of being beautifully laid out with great stretches of grass and large plantations of fine trees; Jackson Park has the attraction of being on the lake, so that the Exhibiton buildings could be grouped along the shore of the fresh-water sea. This arrangement offers many advantages, such as effectiveness of position, facility of dealing with sanitary questions, a close association of the naval sections of the Exhibition with the main scheme; on the other hand, it involves larger outlays in landscape gardening, and it is more than probable that during some period of the Exhibition the lake storms may prove inconvenient.

We believe that, after careful consideration, the lake site has been definitely adopted, and that Washington Park has been preserved for separate pavilions, flower shows, and the like. One of the special features of Washington Park is the racecourse and grounds of a famous Chicago sporting club, and this, with its various accessories, is to be included as a part of the Exhibition. The strip of broad, flat land connecting the two parks has also to be utilized, and its position suggests it as being admirably adapted for conversion into a street of States and Nations. By using it for this purpose, a magnificent perspective of fine buildings presenting many varieties of architecture would result, and the various States and foreign countries taking part in the Exhibition could be provided with ample space for erecting their offices, special pavilions and buildings for entertainment, beside which the famous Rue de Caire would sink into insignificance. Much work for the landscape gardener remains to be done before Jackson Park can be completed, but nature has already assisted greatly by forming a number of large lagoons connected with the lake, which can easily be converted into spacious pieces of ornamental water. It is not too much to say that no such favorable site has ever been placed at the disposal of an exhibition executive, both as regards size and beauty; the great dimensions of the grounds will, in fact, not improbably be a source of embarrassment to the management, especially at night, for it is determined that the Exhibition shall be kept open to the public after dark. The efficient lighting of such large spaces presents almost insurmountable difficulties, one of which is the expense that would be involved; and it will probably be found necessary to follow the example set by Paris in dealing with a much more restricted area, and place only a part of the buildings and grounds at the disposal of evening visitors. Another serious problem which will present itself for solution will be the provision of efficient means of transport within the grounds; this requirement will offer an admirable opportunity to exhibitors of every kind of portable and surface railways, and to every system of traction and motive power. The astonishing success which attended on the little Decauville Railway at the Champ de Mars last year will no doubt be repeated on a much larger scale in 1893, where the necessity for transporting visitors will be much greater.

Objection has been raised that the selected site is too far from the center of the city; this criticism, however, has no weight. In the first place, the means of transport provided will be ample, and the existing lines of railway running past the south parks can be multiplied; it is in contemplation to construct a special railway for exhibition traffic; cable car accommodation can be increased indefinitely, and to provide for the reception of the large number of visitors which the Exhibition will attract, temporary hotel and other living accommodation will have to be provided near the park. Moreover, the road from the city to the Exhibition grounds is a very pleasant one, running along the dead level of the lake shore through Michigan avenue and the magnificent Drexel and Grand Boulevards. As regards the beauty of its approaches, the Chicago Exhibition of 1893 will also be unrivalled.

Although it is impossible to forecast the nature and extent of foreign participation, a tolerably accurate idea of the most important features of the national exhibits is not difficult to obtain. In mining and metallurgy, in agriculture, in live stock, in agricultural machinery, and in labor saving appliances, it may be safely predicted that the Chicago Exhibition will stand pre-eminent. Brewing plant will be a distinctive feature, and railway machinery of all kinds will be of the greatest possible interest; educational appliances, the art of producing books, the industrial applications of electricity, and an almost infinite variety of special machinery for working wood and metals, will make this Exhibition of exceptional interest.

The system of classification has not of course been decided on, though it has received very careful attention by the executive. Generally it is intended that a decimal system of arrangement should be adopted, in which the groups should be divided into ten divisions, and each division into ten classes. It is proposed that the arrangement of groups should be as follows:

1. Agriculture and allied industries.
2. Mines and metallurgy.
3. Marine and fishery.
4. Manufactures and other elaborative industries. This group would include machinery of all classes, the applications of electricity, industrial chemistry, pottery, glass, metal working, furs and leather, textile industries, paper manufacture, etc.

Group 5 would be devoted to food and its accessories, including the production from raw materials, preparation and preservation.

Group 6, "the house and its accessories, costume and personal equipment," embraces the arrangement, heating lighting, ventilation, and water supply of cities; architecture, furniture, dress, jewelry, etc.

Group 7 is devoted to the pictorial, plastic, and decorative arts.

Group 8 is devoted to social relations and public welfare. The last-named group includes music and musical instruments, medicine and surgery, hospitals and charitable institutions; exhibits relating to property and commerce, labor federations, and the art of war.

Group 9 is that of science, religion, and human achievement. In this group would be included scientific instruments of all classes, publications, all sorts of ecclesiastical exhibits, and that special branch of educational work of which we know but little in this country, but which is such an important addition to all American churches.

Group 10 is devoted to monographic and collective exhibits, a group which the executive appear desirous of encouraging, and of granting to special industries the privilege of taking their exhibits from the groups to which they properly belong, and arranging them separately in different parts of the main buildings, or in independent pavilions.

There are many obvious reasons why this method of exhibiting should be encouraged, on account of the advantages it offers to manufacturers and to the public. Agricultural and cattle shows will be of frequent occurrence during the Exhibition, and racing and trotting matches will be held constantly.

The advantages attending the proximity of Lake Michigan will add greatly to the attractions of the Exhibition, and enable regattas and other aquatic entertainments to be held, and for the same reason

scarcely any limit need be set to the importance and variety of the naval exhibits, which it is said are to include a reproduction of the fleet of Columbus.

[To be continued.]

## High-Power Photometry with a Bunsen's Photometer.

Herr Coglievina, of Vienna, has communicated to the *Journal fur Gasbeleuchtung*, an account of a method for working a Bunsen's photometer, only slightly modified in its structural details; and we here summarise his statement, giving, however, arithmetical examples instead of the general mathematical formulæ which he employs. The difficulty in measuring arc lamps, etc., against candles is the difference of color in the two sides of the screen; but if you have an arc lamp on each side of the screen this difference of color practically disappears. Now fix the arc lamp to be tested (which we shall call $(A)$ and a petroleum lamp $(p)$ on one side of the screen; the line joining them is at right angles to the line of travel in the bench; and they are each at an equal distance from the mid-line of the bench. On the other side of the screen adjust another arc lamp $(a)$ and another petroleum lamp $(P)$ quite symmetrically with regard to the first lamps and to the mid-line. The four lamps now represent a rectangle, thus:

$$\begin{matrix} A & - & a \\ | & & | \\ p & - & P \end{matrix}$$

and the screen can be shifted back and fore along the mid-line between the arc lamps and the petroleum lamps. Between the screen and the pairs of lamps, $A\ p$ and $a\ P$, there are diaphragms which just allow the screen to get the full benefit of the two lamps on each side, and no more.

Now comes the novelty. The screen is made to travel, not only along the bench, but across it, so that the arc-lamp light may be shaded off it by the diaphragm, leaving the petroleum lamp alone to shine on it, or *vice versa*. Let us begin with the mid-position, the screen being over the mid-line of the bench, and therefore shone upon by both lamps on each side. Let the distance between $A$ and $a$ or between $p$ and $P$ be 80 inches; and let the screen stand, on equality, at 39.56 inches from the line $A\ p$, or 40.44 inches from the line $a\ P$. Then

$$(A + p) : (a + P) :: (40.44)^2 : (39.56)^2 = 210 : 201,$$

by the well-known photometrical law. Now move the screen so that only the two arc lamps shall shine upon it; and let us suppose that this time there is an equality of illumination when the distances are 39.49 and 40.51. Then

$$A : a :: (40.51)^2 : (39.49)^2 = 20 : 19,$$

$$\text{or, } a = \frac{19}{20} A.$$

Let us now do the same thing with the two petroleum lamps; and let us suppose the distances are now 40.95 and 39.05 respectively. Then

$$p : P :: (39.5)^2 : (40.95)^2 = 10 : 11,$$

$$\text{or, } P = \frac{11}{10} p.$$

In the first proposition, instead of $P$ we may now write its value, $\frac{11}{10} p$; instead of $A$ we may write its value, $\frac{19}{20} A$; we then obtain

$$(A + p : \left(\tfrac{19}{20} A + \tfrac{11}{20} p\right) :: 210 : 201.$$

Working this out we get

$$201\ (A + p) = 210 \left(\tfrac{19}{20} A + \tfrac{11}{10} p\right)$$

$$201\ A + 201\ p = 199\tfrac{1}{2}\ A + 231\ p$$

$$1\tfrac{1}{2}\ A = 30\ p$$

$$A = 20\ p$$

That is to say, by these data the arc lamp $A$ is shown to be 20 times as powerful as the petroleum lamp $p$.

This result may be controlled by reversing the position of the petroleum lamps $p$ and $P$. The value of the petroleum lamp $p$, in standard candles, may be separately ascertained, and the illuminating power of the arc lamp in candles readily computed.

The objection to this seems to be that the difference between the bench-reading for arc lamps alone and for arc lamps plus petroleum lamps is so small a difference. If the petroleum lamp in the the above numerical example had been one-tenth, the difference between the readings would have been twice as great: but even then it would only have amounted to 0.14 inch.

[Official Report—Revised by the Secretary.]

## TWENTY-FIRST ANNUAL MEETING OF NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held at Young's Hotel, Boston, Mass., Feb. 18 and 19, 1891.

### First Day—Wednesday, Feb. 18—Morning Session.

The twenty-first annual session of the New England Association of Gas Engineers was called to order, at 10 A.M., Wednesday, Feb. 18, in Young's Hotel, Boston, by the President, Mr. Charles F. Prichard, of Lynn, Mass.

On motion of Mr. Stiness the minutes of the last annual meeting were adopted as published in the American Gas Light Journal.

### Applications for Membership.

The Secretary announced that applications for membership had been received from the following gentlemen:

*Active Members.*

Dye, N. C., Rutland, Vt. Jennings, F. W., S. Framingham, Mass.
Thayer, W. F., Westfield, Mass.

*Associate Members.*

Cortis, D. F., Boston, Mass. Keith, Dr. W. C. C., Brockton, Mass.
Merritt, C. H., Danbury, Conn. Sprague, P. H., Boston, Mass.
Thomas, F. W., Boston, Mass. Tufts, N. W. C., Boston, Mass.

The Secretary, having read the names, further announced that the applications were indorsed in due form, and that the Directors recommended the applicants for election.

### Election of New Members.

On motion of Mr. Slater the Secretary cast the ballot of the Association for the election of the gentlemen named.

Applications were received from Nathaniel W. Gifford and Frank P. Fairbanks, for transfers from Associate to Active Membership. The applications having been approved by the Board of Directors, Messrs. Gifford and Fairbanks were, on motion of Mr. Stiness, made Active Members of the Association.

### Report of Committee on Badges.

Mr. Stiness—Your committee, appointed a year ago to procure badges for members of the Association, respectfully report that they have adopted a badge similar to this which I now present, and which is a monogram of the initials of the New England Gas Engineers' Association. It was expected to have the badges here to-day, ready for distribution, but owing to a mistake of the maker they are not here. The cost is to be $1 each, and it is needless to say they are not made of solid gold, but they are made of very heavy plate, and will last for many years. If any member of the Association will leave his name with the Secretary, or with myself, he can procure the badge, which will be sent by mail in a few weeks.

On motion of Mr. Leach the report was accepted and the recommendation adopted.

### A Tender of Sympathy to the Family of the Late W. H. Down.

Mr. Harbison—Before the President's Address is read I ask permission to interrupt the regular order for a moment or two. All the members of this Association have no doubt by this learned of the death of our friend, William H. Down, of New York. Although not a member of this Association, he was very dear to each one of us, and many of us were intimately acquainted with him. He always took great pleasure in attending our meetings, and we were always glad to welcome him. I think it is due to ourselves, as an Association, that we should send to his family a message of sympathy in their affliction. I therefore move that the Secretary be instructed to convey to them the sympathies of this Association in their present bereavement.

Mr. Stiness—I second the motion.

The President—It is moved and seconded that the Secretary be authorized to send to the family of Mr. Down, a telegram, expressing the sympathy of the Association with them in their affliction. (Adopted).

Mr. Harbison—A number of gentlemen last night took the responsibility of ordering, by telegraph, a floral tribute to be sent to the house of our deceased friend, Mr. Down, in the name of the Association and I move that the Treasurer be authorized to pay the expense of same.

Mr. Stiness—I second the motion. (Adopted.)

## PRESIDENT'S ADDRESS.

The President read the following address:

Gentlemen of the New England Association:—We are entering now upon the 21st year of the life of this Association, and to-day celebrate its 21st birthday. From a little meeting of 23 gentlemen gathered to pay their last respects to a departed friend and fellow-laborer, it has grown in strength till to-day it numbers nearly 150 members; it has on its roll members coming from every part of New England, from Eastern Maine to Western Massachusetts, from Northern Vermont to the shores of the Sound. It is the oldest of the Gas Associations—the mother of them all, as we often say, and is one of the oldest societies formed for the discussion of purely technical subjects in the United States.

If you will glance back through its records you will find them full to overflowing with papers and discussions touching upon almost every conceivable topic o' interest to the gas engineer; problems of physics, chemistry, thermodynamics, mechanics and finance; problems treated theoretically and scientifically, but, perhaps best of all, questions settled by personal, often bitter, experience of someone who gives freely of his knowledge for the benefit of his fellow-members. In no other Association will you find actual results obtained, and even serious mistakes made, given to others in so free and frank a manner as here; and it is a serious problem of the gas business indeed upon which some light cannot be thrown by carefully studying what some man of experience has said to the members of the New England Association.

Therefore I urge upon you, as one of the most important things you can do, to attend not only these meetings, but the smaller gatherings where a few men discuss their daily methods and results.

In the field covered it is folly for any one to think he knows all, or for him to expect by personal experience to solve even a small fraction of the problems daily presented; but let the 150 members of this Association give freely of their own experience to each other, and the business of the gas engineer will go on with an impetus it has never before known.

Contrary to what might naturally be expected from its age, the Association is composed largely of young men. With them is coming the scientific education, which can be brought to bear more closely than in the past upon the daily results; and there is no reason to doubt but what the manhood of the Association will be all that its youth will lead one to expect.

You will pardon me, however, if I criticize in one respect. The difficulty of obtaining mental food for these meetings is a matter realized but little by those who have not been near the Secretary in his, at times, almost hopeless struggles for papers—not but what the Association contains plenty of brain and experience, but its members are prone to let the burden fall on a few, forgetting that it is but fair for them to devote time and study, in return for the results of time and study which others have given to them.

One reason is, I think, that members are called upon so late in the year that they cannot devote sufficient time to investigate any one question to their satisfaction; therefore, I would suggest for your consideration, in addition to the usual manner of obtaining papers, that a committee of two be appointed, who, early in the year, shall decide upon some ten investigations which they think will be of general interest to the members; that they shall select several members who can with least inconvenience obtain the information wished, and ask them to follow out the subject, the members or the committee to report at the next meeting. As an example, several members having charge of small works might be requested to run a week using the oil cartridge, and a week injecting oil, the average of their results indicating to us the true course; and so with coal as against coke for water gas making, and many similar questions.

As we turn from ourselves as an Association we are reminded that the past year has taken from us three of our members, each of whom was particularly prominent in that class to which he belonged.

Gen. Charles Roome, one of our honorary members, and, if I am not mistaken, the first we ever had, died on June 28th, 1890. While many of us did not have the honor of a personal acquaintance, all knew his fame as an engineer, and all recognized the ability and skill which was necessary to successfully guide as President the affairs of the Manhattan Company, of New York, through 30 years of its existence.

Of our active members we are called upon to mourn the loss of James H. Rollins, of Worcester, who died on June 19th, 1890. There can be no one here who does not well remember his kindly face and hearty grasp. He was a very active member of this Association, always attending its meetings, and had its welfare thoroughly at heart. He served many times on its Board of Directors, took a very active part in its proceedings, and his name appears very frequently on its records as participating in its discussions and the reading of papers. It was my good fortune to get the first insight into the gas business under his tuition, and to be intimately acquainted with him for about two years, and from this intimate acquaintance I can testify that as a man and an engineer he had few superiors. He was one of the most clear-headed business men I ever met; as an executive officer he had few equals. He had a thorough knowledge of every branch of the gas business, and personally saw that every detail was carried out with but one end in view—that of producing the best gas at the cheapest rate. As an engineer he was broad, far-seeing and progressive. One of the first water gas plants in New England was built by him at Worcester, as well as some of the first regenerative furnaces. Large-hearted, honest and manly, he was one whose friendship was well worth seeking.

Again, in our list of Associate Members we mourn the loss of Nathaniel Tufts. Mr. Tufts was well known not only to all here, but to the fraternity at large; and nothing that I can say will add to your kindly memory of him. The lists of this Association can never contain the name of a man more upright, more honest, with kindlier heart and sweeter disposition than Nathaniel Tufts. For these traits he was universally esteemed and respected His place is one not easily filled.

And as we sit here now in the full flush of health, there comes to us from the distance the muffled tones of the bell announcing the passing away from our sight of the form of one whom we loved and who loved us well—William H. Down. Were he in life and health he would be among you now, and even death cannot separate from us the pleasant memories of his comradeship. Truly the year has borne heavily upon us.

It is to not be expected that a business so thoroughly developed as the gas business should show any marked change in one year, either in the forms of apparatus used or in the methods employed. It is clearer now than a year ago that the regenerator furnace, with a moderate amount of recuperation, fills our requirements best; and such furnaces are being adopted. The increased demand for ammonia water, together with the large district from which one factory must draw its supply of crude liquor, has made necessary the adoption of the "Standard" washer, or some similar apparatus, which would produce a strong liquor, and a concentrator to still further reduce its volume to cheapen the freight charges.

The methods and apparatus of condensation and purification remain the same; but as it has been recognized in the past that time and uniformity of flow are the prime requisites of a successful condensation, so have our increased makes and our attempts to purify water gas without a relief holder forced us to recognize that time and uniformity of flow are also prime requisites in purification. This point will be brought before you more fully in one of the papers to be presented.

Our quality is being improved; leakage is being steadily reduced; and, in general, progress is being made in every department.

Perhaps the most encouraging thing during the past year has been the increase in the value of the residual products. Coke has had a ready market, and has been worth 10 cents a bushel in the yard to those who have a water gas plant and pay Eastern prices for coal.

Ammonia is in good demand at high prices, while tar is now selling at higher prices than ever before. This is due in part to the reduction in the supply caused by many large works going more extensively than ever into water gas, and partly to the increased demand for pitch and the other products of tar.

On the other hand, the condition of the coal market during the past season has been trying; it has been difficult to get coal at all, and the coal we were obliged to accept has been poor in yields, rich in sulphur, and high in price. Undoubtedly the rise of price and the fall of yields has cost the gas companies of New England several hundred thousand dollars more this season than last for the item of coal alone, and it has required the utmost skill and attention to produce a gas which would meet the requirements of the State law as to freedom from sulphur.

During the year the carbonic oxide law has been repealed, and companies in Massachusetts are now free to manufacture water gas if they desire; but although gas coal has been high in price and poor in quality, and, on the other hand, naphtha and oil have been extremely low, the privilege has not largely been used, as even at present prices there is but little if any saving. Yet its value, particularly in seasons like the past, has been seen; for we are not confined to one market for our raw material.

The water gas apparatus of to-day is far ahead of that of 10 years ago in ease of operation, quality of gas produced, and economy of manufacture. Its extreme flexibility, if I may use the word, is much in its favor; an apparatus which, without cost except the interest account, stands ready to be put in an hour's time in condition to make a couple

of hundred thousand feet of gas in a day, is a valuable adjunct to any works, and adds still more to the reliability of the gas supply. As a method of enriching, the addition of a moderate amount of water gas makes a mixture which in many respects is superior to either; the candle power is easily controlled, while the higher flame-temperature of the water gas give a whiteness and brilliancy to the flame which commends it to the public eye.

The general condition of the gas business of New England was never better than to day. The business has always been peculiarly liable to attacks of various kinds. Never, to my knowledge, was there a time when some process, some new discovery, or some legislation was not making it merry for the Gas Company, and the present time is no exception, with electric light on one hand, and municipal legislation on the other. Yet it seems to flourish; an average increase in business is reported of about ten per cent. The stock quotations, the sure indicators of how the thinking public regard any manufacturing enterprise, show a decided rise in values this January over the January of a year ago, notwithstanding the tightness of the money market of this year; while to even the opposite extreme the condition of the gas business is so alluring that it is suggested that every one become a stockholder or part owner of a gas or electric light company, operated by the town or city of which he is an inhabitant.

You would not expect any review of the question of municipal lighting, or any attempt to controvert or even enumerate the engineering fallacies given to the world in the discussions of this question. One or two are fair samples of the lot: The almost universal blunder is made, that the cost of material and labor used in actually manufacturing the gas or electric light covers all expense. If this were so, cities and towns should supply water at the simple cost of pumping it high enough to run to its destination, and natural gas in the gas regions should be supplied for nothing; but as a large amount of money has been expended for reservoirs, buildings, pipes, meters, etc., and the town or city has to hire money and pay interest on it for this purpose, and large gangs of men are constantly at work relaying mains and replacing pipes and machinery, so a gas or electric light company has money invested in its plant on which interest must be earned, and men in its employ to attend to the distribution and make good the wear and tear; therefore to the cost of the manufacture add interest, repairs, depreciation, taxes, water rates, expenses of distribution and of collecting the bills, and we begin to approximate the cost.

Again, as engineers, we may wish to say a word on the comparison of our cost of manufacture with selected instances taken from English practice. Gas is a manufactured article, into which the cost of raw material enters but very little. Direct and indirect labor is the all-important item; and by indirect labor I mean the labor necessary to mine our coal, bring it to us, burn our lime, furnish our supplies—in fact all the labor involved in taking coal from the mine and putting gas at the burners. It is the pride of the American nation that her working men, both skilled and unskilled, are well paid; that they live in comfort, and even luxury. I can point you to day retort house stokers whose daughters cannot be told from the best dressed ladies of our cities, and whose sons are educated for the professions. Yet our near-sighted friends, the Nationalists, are clamoring on the one hand for higher wages and better opportunities for labor, and on the other, by crying down the price of labor's product, seek to reduce our workingmen to the lower position of the English workingmen. Give any engineer here labor at English prices, and apparatus and supplies furnished by labor at those prices, and it is an easy problem for him to furnish you gas at English prices.

But putting aside the secondary thoughts of indirect taxation, the question as to whether it is justifiable to use public money in a hazardous business, the old, alluring promise of cheaper light, that never failing lever to more legislation, ever being promised by promoters, but never fulfilled except by a reliable company of home citizens, stripped of all misleading thoughts, there remains this fact: With gas and electric light companies in Massachusetts organised as they must be by law on a paid in capital, governed by a Gas Commission, earning as the Commissioner's reports will show, not over 6 per cent. on their entire capital stock, managed with a skill and economy not surpassed in the world, how can cities and towns expect to hire money and do any better in price, hampered as they will be by political rings, by lack of personal interest and the changing managements natural to municipal affairs? I clipped from *Electrical Enterprise* the following, which contains much truth:

"The municipal ownership of gas plants is nothing new, for more than a quarter of a century it has been a common practice in England; but by far the greater number of works are in the hands of private corporations. Even London itself is supplied by such.

"Furthermore, public plants are not so skilfully superintended. There is not to-day a single prominent gas engineer connected with the management of a corporation plant The talent and skill are all with the private companies. Improved appliances and processes are not favored by municipal boards of control, as has been proved again and again by the course of events in England."

Whatever we may think of electric lighting as an investment, or as an addition to our present business, the question which concerns us here to day is its bearing upon the gas industry. The extent to which the arc light will cut into the gas business is now known; its boom is over, and its gain now a question only of the growth of the towns and cities. Its fitness for lighting large areas and streets has been demonstrated, and it undoubtedly has a large field of usefulness. It lacks many things, notably steadiness of candle power; and it is a question if the simple arc lamp of to-day, with its varying length of arc, is equal as a light giver to the older complex with its much better regulation.

Electricity as a means of illumination now only threatens to reduce the output of gas through the incandescent lamp. There a loss of business is to come which must be made up by the newer class of people whom we induce to burn gas each time we reduce the selling price and improve the quality, and by the users of gas for fuel purposes. The incandescent light will take its place in stores and houses to a large extent—just how much it is hard to say, much depending upon how its faults are overcome. It lacks reliability; it lacks ability to adjust the power of light; it rapidly loses its efficiency and at the same time increases the power absorbed; and upon these points recent tests show no progress made toward a better condition. Its selling price has been put full low consistent with fair interest on the money invested, and has in many cases been put too low. It is a question if a 16-candle power incandescent light can be furnished at much less than one cent per hour with profit; yet 18-candle power gas at $1 a thousand is quite possible, in which case a 5 foot burner would cost but one-half cent. Its advantages you all know. I have enumerated some of its disadvantages in support of my belief that the electric light is not to be a destroyer of the gas industry, but an honest competitor. The companies who have added it to their gas business appear well satisfied, although naturally an industry so young has many weaknesses.

Turning to the future, to increase the amount of gas sold, there are three things to be done. Its quality must be improved, its price cheapened, and the fuel business cultivated.

In the matter of price the gas industry has shown wonderful results in the past ten years. I regret I am not able to give you the average reduction in selling price in Massachusetts, but you will find companies who have made reductions of 30, 40, and even 50 per cent., and this is still going steadily on. The price of either of the three means of artificial illumination—gas, electricity and oil—is now within the means of the average consumer, and price is a powerful argument for or against either; but as people become educated to the various qualities of light they will demand the best, and our aim in the future must be directed toward producing a better quality, if possible. While lights of all kinds have some points in common, I need not point out to you that there is a great difference between the bluish glare of an arc light and the yellow light of an oil gas flame; just so true is it that there are differences between the water gas flame, the coal gas flame, the flame of a mixed gas, the Welsbach mantle, and the incandescent lamp. All these have not only different qualities, but different illuminating power per unit of area. The light of day entering a broad window might not measure more on a photometer in the center of the room than if the light came from the small points and arc of an arc light placed opposite the window; yet there is no question but what the diffused light of day is much to be preferred, and so in a lesser degree does the variation of the area of the sources of artificial light affect the eye. Little attention has been paid to quality till lately, but Prof. Edward L. Nichols has contributed a paper to the American Institute of Electrical Engineers which throws much light upon the subject, and it is hoped we may be still further enlightened.

In the use of illuminating gas for fuel there opens a wide field, just beginning to be understood. There will be a very large demand for gas for fuel, but the fuel gas business will not revolutionize the heating business, as enthusiasts would have us believe; and this is so because of cost. If a person burns 10 tons of coal during a winter to heat his house he will apply 260,000,000 heat units to this purpose. To obtain this heat from illuminating gas of 20 candle power, at 700 heat units per foot, would require 370,000 feet; if from fuel gas, of 320 heat units per foot, it would require 812,000 feet—the waste heat going to the chimney would be substantially the same in either case. With coal at $6 per ton the cost would be $60; with illuminating gas at $1 per 1,000, the cost

would be $370; and with fuel gas at 50 cents, $406. The extra cost is so excessive that no one seriously thinks of house heating or of steam boiler heating by a distributed gas.

On the other hand, if he wishes to boil two quarts of water (about 4 pounds) it would require not less than 5 pounds of coal from the beginning to the end of the operation, costing 1½ cents, while 2 feet of gas costing two tenths of a cent, would do the work much quicker and with less labor expended.

Between these extremes are an infinite number of operations, the smaller ones showing a profit for gas, always with decreased labor. This percentage of profit gradually decreases as larger quantities of heat are required, till no economy is shown, and their profit appearing on the other side till the extreme is reached, in continuous operations requiring large amounts of heat.

There being this field, the ground was taken, in a paper read before this Association five years ago, that ordinary illuminating gas sold at reasonable rates was better able to supply the demand than any of the so called fuel gases at the prices proposed. This statement is is true to-day as then, and facts developed in the interval make it clearer. Nothing new has been developed in fuel gas, unless it be negative results as to the commercial success of distributing it in towns and cities. Even in manufacturing plants it shows but little economy, but at has shown that it is a much better fuel, and that by its aid a better quality of goods can be produced.

No proofs have been given that a unit of heat can be produced and distributed in the shape of any of the so called fuel gases cheaper than by illuminating gas. In fact, the showing of General Hickenlooper, and Mr. Cowdery, is to the contrary.

About one-third of the total increase of business during the past year is attributed to gas used as fuel.

Better stoves and apparatus are being made for the utilization of its heat, its advantages are being better understood, its demand is increasing, and it is quite within the bounds of possibility to expect that before many years the output of gas for heat will equal the output of gas for light.

Mr. Stiness—I move that the thanks of the Association be tendered to Mr. Prichard, our President, for his very able and interesting address; and that his recommendations be referred to a committee with instructions to report thereon at this meeting of the Association.

The motion was agreed to, and the following committee was named by the Secretary: Messrs. A. B. Slater, W. A. Wood and W. A. Learned.

(To be continued.)

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT the annual meeting of the stockholders of the National Gas Light and Fuel Company, held at the office of the Company, 218 La Salle street, Chicago, on the 10th inst., the following named gentlemen were elected Directors for the ensuing year: Messrs. C. D. Hauk, E. E. Morrell, George H. Sonneborn, James K. Davis and N. A. McClary. At the Directors' meeting, held immediately after the adjournment of the stockholders' meeting, the following organization was effected: President and General Manager, C. D. Hauk; Secretary and Treasurer, N. A. McClary; Engineer, E. E. Morrell.

AT the last regular monthly meeting of the Directors of the New Bedford (Mass.) Gas and Electric Light Company the important measure under consideration was the issuing of bonds to cover certain debts of the corporation. The sentiment appeared to be in favor of the proposition, and it was resolved to call a meeting of the shareholders to obtain an expression of their opinion as to the advisability of the bond issues.

A WORKS Manager, who has under his supervision three gas plants—an electric light supply is also furnished from each plant—submits the following statement of fuel consumption of steam power, used at two of his stations, and of gas power used at another station, on very light loads for all engines—the experiments all having been carried out on the same day, August 25, 1890:

| Station. | Engine. | Hours Run. | No. of Lamps. | Fuel Consumption per Lamp per Hour. |
|---|---|---|---|---|
| O. | 12 × 12 Ball (steam)..... | 6½ | 21; 1,200 c. p. | 18 5 lbs. |
| F. | 12 × 12 Ide (steam)..... | 6½ | 17; 2,000 c. p. | 20.6 lbs. |
| R. | 50 H. P. Otto (gas engine) | 5½ | 18; 2,000 c. p. | 7.75 lbs.* |

* Equivalent to 38 feet of gas consumed.

With steam the coal was reduced to ash, while with the gas engine as the power source, the manager still had the value of the bye-products, coke, tar and ammoniacal liquor, to reduce the power cost.

THE Elgin (Ills.) American Gas Company reports a very flourishing business. The proprietors have about determined to make considerable addition to the main system, and the latter will undergo a general overhauling, as the city has determined to pave anew the streets that are in the fire limits district.

AT the annual meeting of the Malden and Melrose (Mass.) Gas Light Company the following result was reached: President, J. T. Foster; Treasurer and Clerk, George D. Bell; Directors, J. H. Converse, E. S. Converse, S. B. Hildreth, D.W. Gooch, Daniel Russell, A. M. Copp, L. P. True, David Cox, J. T. Foster and George D. Bill. As an earnest of their good business management, the Directors ordered that the price of gas be reduced to $2 per 1,000 cubic feet, with discount of 20 cents per 1,000 for prompt payment, the concession to date from April 1st. A quarterly dividend of 2 per cent. was declared last January.

A CORRESPONDENT at Providence, R. I., incloses the following respecting the history of the Woonsocket Gas Company: "The Woonsocket Gas Company is one of the old-established corporations. It pays its bills regularly, and disburses 6 per cent. dividends semi-annually. Some time in 1850 a number of influential local manufacturers and business men agreed that the residences, stores and mills in this city should be better lighted. They talked the matter over, and in 1851 a charter was granted to the Woonsocket Gas Company. The incorporators were Messrs. George S. Wardwell, Samuel Greene, Edward Harris, Willis Cook, George C. Ballou, Edward H. Sprague, William Metcalf, Stephen N. Mason, Oren A. Ballou, Eli Pond and Horatio Latham. Of these men only Messrs. Metcalf and Pond are living. The capital stock was $25,000. The Company bought, practically, the land now owned by the Company, on the right bank of the Blackstone river, near the Hamlet avenue bridge. Very little land has been added to that secured by the first purchase. May 27, 1852, the charter was accepted. The stockholders chose as Directors Messrs. Gardner Warren, Amory Warren, Samuel Greene, George S. Wardwell, Oren A. Ballou, Aaron Rathbun, Edward Harris, Hiram Allen and Ira B. Peck, and these men, on organization, chose George S. Wardwell President, Oren A. Ballou Secretary, and John B. Walker Treasurer. The Company began to make gas in the fall of 1852, and laid the first supply pipes in 1853. During that year the system was extended to Blackstone. June 5, 1854, it was voted to petition the Legislature for an increase in capital stock from $25,000 to $80,000. Two or three increases in the capital stock of the Company have since been made, until now it is $250,000. In 1857 the present incumbent, Henry B. Kimball, was elected President, and he held that position until now, having been elected and re-elected 34 times. R. Randall is the Secretary and Treasurer of the corporation, and Oscar J. Rathbun is Secretary of the Trustees. The present Board of Directors comprises H. B. Kimball, Oscar J. Rathbun, Joseph Cole, James P. Ray, H. F. Lippitt, John W. Ellis, Gilbert Darling, George Willes and Frank Harris.

"Over 600 customers are supplied by the Company, and they have about 1,000 meters in use. An amendment to the charter was obtained in 1882, granting the Company the right to furnish electric lights. All the capital of the Company is employed, and the construction account of the Company is $300,000, being larger than the capital stock. The Company is in a healthy condition financially, and has steadily prospered. It began to pay dividends in 1858, and has paid semi-annual dividends of from 6 to 8 per cent. since that time. The dividend for the past 10 or 12 years has been 6 per cent.

"The old stone retort house, built in 1852, is still standing. It contains 4 benches, or 1 stack of retorts, 20 in all. Later, purifiers and condensers were added on a small scale. The Company erected 2 holders or gasometers during the first few years, one at the works and the other at Blackstone. About 25 years ago the Company erected a gas holder with a capacity of 100,000 cubic feet, and also built a holder of 10,000 cubic feet capacity. In 1872 a gas holder with a capacity of 100,000 cubic feet of gas was constructed at Fairmount. A new stack of twenty retorts was added about this time. In 1878 and 1879 the works were practically rebuilt. The old stack of retorts was torn down, and in its place a new stack, consisting of four benches of six retorts each, was erected, and the new system of underground regenerative furnaces was put in. The old purifiers were taken out, and four new ones, 10 by 16 feet, were set up. A new multitubular condenser was also placed in position. A brick addition was built to the stone building to hold these machines. In 1886 Superintendent Jencks took out the remainder of the old-style retorts and erected four more benches of six retorts each. The total gas making capacity at this time was 300,000 cubic feet a day, of coal gas. The Company has about 18 miles of mains, ranging from 2 to 10 inch pipe. Four miles of pipe have been added in the past 10 years.

The Company is on the line of the N. Y., P. and B. Railroad, and a side track runs past the coal sheds.

"The water gas plant was established the fall of 1888. The apparatus is contained in a brick building, 21 feet wide by 40 feet long, and 28 feet high in the clear. The structure contains a double set of water gas apparatus of the Granger-Collins type; each set with a rated capacity of 100,000 cubic feet per day. Incidentally Superintendent Jencks made 175,000 cubic feet of water gas with one set of the apparatus some time ago, so that the total capacity per day can now be claimed to be about 350,000 cubic feet of water gas. The water gas apparatus consists of two generators, two superheaters, or fixing chambers, two condensers, two Knowles hydraulic pumps for distributing oil, two 10-horse power high-speed Westinghouse engines, two No. 4 Sturtevant blowers, one 100-horse power boiler, and a 65 foot brick chimney with a 30-inch flue. The Company has not made any coal gas since last April, although the coal gas apparatus is kept in order, so that the Company is prepared for any emergency. The Company considers water gas to be much cheaper than coal gas, and it is more easily made and handled. One reason for adopting and manufacturing water gas here was this, in manufacturing cities a cloudy or dark day may cause a sudden and great demand for gas. When coal gas is used the apparatus has to be kept in operation day in and day out to supply the maximum demand. With water gas, a sudden demand may be quickly met, and no loss by reason of wear and tear of apparatus need to be entailed. Fifty thousand gallons of oil per year are used in the manufacture of water gas, at the local works. During the past year a relief holder, consisting of a steel tank, 42 feet in diameter, and 14 feet 6 inches deep, has been constructed. This will hold 15,000 feet of water gas, and is used to store the crude water gas as it is generated, and before it is sent to the purifiers. The meters of the Company range from 2 to 500-light meters. The output of the Gas Company is 30,000,000 cubic feet of gas per year. Woonsocket being a manufacturing city and not having a large number of residence-consumers of gas, the gas stove business is somewhat limited. The Company has about 50 in operation, ranging from a small cook stove to large ranges and boilers. A number of gas lamps of the Lungren patterns have been put in local stores and are giving satisfaction.

"The Company secured an amendment to its charter, granting it the right to furnish electric lighting and power, and in the summer and fall of 1889 erected a brick building 45 feet wide, 28 feet long and 21 feet high in the clear, with a trussed gravel roof. The inside of this building was sheathed from top to bottom, and furnished with a hard pine floor. The electric lighting machinery comprised two Brush 45-light divided arc dynamos, and a 600 light Brush alternator for incandescent lights. The motive power for this business is furnished by two 50-horse power Otto gas engines, supplied with water gas. The Company has 52 arc and 400 incandescent lights in operation. The electric lighting part of the plant is simply an auxiliary, and was put in by the Company at the solicitation of some of its customers.

"The Superintendents of the Company since the erection of the works have been Amory Warren, Ira B. Peck, Waldo Earle, Samuel P. Walker, Benjamin G. Raymond, Charles F. Smith and Zeuner M. Jencks, in the order named. Thomas R. Cooper is the electrician, and George Chamberlain is assistant electrician. Elmer F. Widmer is dynamo tender and George Smith engineer. Superintendent Zeuner M. Jencks entered the employ of the Gas Company Oct. 28, 1874, to learn the business, and he steadily advanced until he has become Superintendent. Mr. Jencks was born in North Attleboro, Mass., May 23, 1857. His parents moved to Pawtucket while he was an infant. They lived in that place a number of years, and then came to Woonsocket, where Jencks was educated in the High School. He entered the employ of the Gas Company under Superintendent B. G. Raymond and worked up, occupying various positions, until, in 1881, he was elected Superintendent. He has since acceptably filled that position. Foreman Cook has nearly completed 10 years of service with the Company, and has not been off duty 10 days on account of sickness during that time. Superintendent Jencks has a record equally as good during his 16 years of service."

---

We are indebted to a Columbus, O., correspondent for copies of bills affecting the gas interests of Ohio, which bills are now before the State Legislature, on motion of Mr. Counts. The first (numbered on the House Bill calendar as 1,275) of these seeks to amend section 1,681 of the Revised Statutes of Ohio, and is as follows:

"Section I.—Be it enacted by the General Assembly of the State of Ohio that section 1,681 of the Revised Statutes of Ohio be amended to read as follows: 'No person shall be eligible as a member of the Council who holds any municipal office or is an employee under the government of the corporation; *or who is a member of, or interested in any company, corporation or association furnishing the city or village, or the citizens thereof with water, natural or manufactured gas, or electric lights.*'" Then follow the sections respecting what is repealed, and when the Act shall take effect.

The second bill (register number, 1,276) seeks to amend section 2,478 of the Revised Statutes of the State to the following—the changes made in the original statute are shown in the italicized words: "Section 2,478. The Council of any city or village in which electric lighting companies, natural or artificial gas companies, or gas light or coke companies may be established, or into which their wires, mains or pipes may be *or have heretofore been* conducted, are hereby empowered to regulate from time to time the price which said electric lighting, natural or artificial gas, or gas *light* and coke companies may charge for electric light, or for gas for lighting or fuel purposes furnished by such companies to the citizens, public grounds and buildings, streets, lanes, alleys, avenues, wharves and landing places; and such shall, in no event, charge more for any electric light, or natural or artificial gas furnished to such corporation or individuals than the price specified by ordinance of such council, *but shall furnish to said corporation and the citizens thereof, at all times, without discrimination, gas or light on payment of, or on being tendered, the price specified;* and such council shall have power to regulate and fix the price at which such companies shall charge for rent of their meters; *to regulate the size of, and the price to be charged for the use of all mixers where gas is used for fuel, and the pressures to be maintained in the gas mains or service pipes; to make such reasonable rules and regulations as may be deemed necessary to the safe conduct of the business of such companies within the carporation, and all such companies in the conduct of their business shall be governed by the special provisions contained in the remaining sections of this chapter.*"

---

The annual meeting of the Leominster (Mass.) Gas Light Company was held on the 10th inst. The Treasurer reported the net earnings of the Company, for the year ending December 31st, 1890, to be $2,038.22, or a fraction over 4 per cent. on the capital stock, $1,000 of which had been paid in dividends, $692.87 expended in the extension of gas mains on Orchard and Walnut streets, $54.75 paid out for new meters, and the profit and loss balance increased $290.60 from one year ago, making it $2,001.94 at the close of the year's business. He also reported that the sale of gas, for the 6 months ending December 31st, was larger by 20 per cent. than during the corresponding 6 months the previous year. Two hundred and thirty-six shares of the stock were represented at the meeting, and the following named persons were unanimously re-elected as officers for the ensuing year: Clerk and Treasurer, Howard M. Lane; Directors, Charles L. Joslin, Nahum Harwood, George F. Morse, Cephas Derby and George Hall. At a meeting of the Directors, held subsequently, Charles L. Joslin, Esq., was unanimously re-elected President.

---

Mr. Burdett Loomis informs us that he has entered into a contract under which he will put up for the American Iron and Tube Company one of the largest fuel water gas plants ever erected. It is calculated to produce over 2,000,000 cubic feet per diem, and the fuel will be chiefly employed in the welding of wrought iron pipe. The furnaces are to be of the special Pettibone patent for water gas, and pipes 30 feet in length will, under the new plan, it is claimed, be heated in one-half the time that is taken up when using coal or Siemens gas. The heating will also be performed more evenly throughout the material. The estimate is further made that the saving of time effected by the use of the water gas fuel will enable the mill to double its capacity without increasing or adding to the welding machinery. Mr. George Matheson, President of the Company, and inventor of the celebrated Matheson joint, which is one of the Company's specialties, is a pioneer in the use of gas for this sort of work, having built Siemens furnaces 20 years ago. He has lately returned from Europe, where much of his time on the last trip was taken up in investigating everything of note connected with improved fuel gas processes and their applications, and he is our authority for the statement that the Loomis generator exceeds all its contemporaries. Messrs. Bartlett, Hayward & Co., of Baltimore, have the contract for putting up the plant.

---

The Mount Holly (N. J.) Electric Light Company—its business is chiefly the supply of incandescent lights—seems to be in a bad way. This opinion springs from the fact that Manager Frank Flinn has tendered his resignation, to take effect on March 1st. Mr. Flinn, it appears, undertook to operate the station on a receipt of $2,200 per year, he to pay running expenses of all sorts, and to obtain his remuneration from the balance. We presume Manager Flinn eats at least one meal a

day, and wishes to pay for it; hence his determination to engage in another business.

AT a special session of the Milwaukee Common Council the sum of $300 was appropriated to cover the expense of carrying out a "full investigation" of charges made by certain local cranks that the Milwaukee Gas Company has for years been using in the street lamps smaller burners than those called for in the contract. The Company, in a formal communication to the Council, courted the most complete examination, and asserted that it had carried out its contract in perfect good faith, and in entire accord with the spirit and terms of the agreement.

MR. TAGGART, of Goffstown, has introduced a bill in the New Hampshire Legislature, which provides that the Mayor and Board of Aldermen of every city, and the Selectmen of every town, in which gas light companies are located shall cause the gas of every such company to be tested, at least four times every year, by "some suitable person designated by them and not in the employ of any gas light company." When the gas of any company is found, on two consecutive inspections, to give "less light than 15 standard English candles, or contain more than 20 grains of sulphur or 10 grains of ammonia per 100 cubic feet of gas, or more than 10 per cent. of carbonic oxide, or any sulphureted hydrogen, a fine of $100 shall be paid by the company to the city or town in which the company is operated." Another provision of the Taggart measure directs that when the annual net income of any gas light company shall exceed 10 per cent. upon its stock the price per 1,000 feet shall be reduced to consumers, proportionate to such excess.

ANOTHER change has been made in the Board of Direction of the Salem (Mass.) Gas Light Company, the members whereof now are Messrs. John T. Langmaid, Henry A. Hale, David Moore, Arthur W. West and B. H. Fatens. Mr. B. H. Shuman was elected Clerk, and Mr. David Moore was chosen Treasurer.

REPRESENTATIVE TAYLOR, of Guernsey, has introduced into the Ohio Legislature a bill to protect gas companies from violence and fraud. Under its provisions anyone convicted of tampering with the main or service pipes, or the meters of a gas company may be punished by either fine or imprisonment, or both.

THE Columbus (Ohio) Gas Light and Coke Company has formally notified the Board of Public Works that it will furnish any required number of gas lamps for the public lighting, to be lighted on all dark hours, at the rate of $13.85 per post per annum.

THE capital stock of the Brookline (Mass.) Gas Company has been increased to $500,000.

A MOVEMENT is on foot at Fort Dodge, Iowa, to cause the purchase of the local electric light company's plant by the authorities, they to operate the same on municipal account.

WE said some time ago that the Board of Aldermen of Milwaukee were anxious for the appointment of a gas inspector, on the ground that the public service would be a great gainer thereby. Mayor Somers, however, does not take kindly to the idea, basing his objection to the scheme partly on the ground that the Mayor of Detroit, in his last annual message, recommends the abolition of the office of gas inspector in that city, because "its maintenance is a useless expenditure of public moneys."

ELSEWHERE in our "items" will be found a hint or two in respect to the relative availability of steam or gas power for driving the generating apparatus of electric lighting stations connected with gas plants. Since that was written we have received the following letter from Mr. John Rodgers, Superintendent of the Racine (Wis.) Gas Light Company, the main facts in which are very similar to those in the first "item" bearing on the subject. Mr. Rodgers, who writes under date of the 14th inst., says:

"To the Editor AMERICAN GAS LIGHT JOURNAL:—In your issue of Feb. 2 you propound a series of questions originated by Mr. William Enfield, of Dallas, Texas. I have been running sixty-five 2,000-candle power Brush arc lights for the past two years, with two Otto gas engines; and at the same time, side by side with the above, sixty-five 2,000-candle power Brush arc lights with a 12 by 12 high-speed Ide steam engine. I have no trouble whatever in starting gas engines. The power is both uniform and prompt. The lights are both steady and uniform; in fact, where I have just put in an Otto gas engine in place of a Westinghouse steam engine, running 310 revolutions, the power appears to be steadier. I clean valves every week as a rule; but if they get foul, or begin to leak, I would do it daily, if necessary, as the operation does not take up much more time than that absorbed in cleaning the tubes of a steam boiler. The governor is very sensitive, and does its work well, as the load is thrown on or off—say, from 9 lights to a full load. It saves more gas, comparatively, than a steam engine does coal on a light load. It will take 7 lbs. of Pittsburgh lump coal per lamp per hour on the circuit, against 30 cubic feet of gas per lamp per hour on the circuit. Of course, with the steam engine, one must count on the hauling of coal to and the removal of ashes from the power room, whilst with gas you have the further credit coming from sales of coke and tar. Or, you may figure it on the basis of cost of gas per 1,000 cubic feet, in the holder—as there is no leakage; again, you can make your estimate on exactly what it costs you to make the additional gas used in the engine. On no matter what basis I have figured, the inevitable result is that gas is far cheaper than steam. If you are particular to see to it that the valves are kept clean, the power from a gas engine is more reliable than that from a steam engine. I give you the above as my experience for the past two years. Not wishing to take up too much of your space, I have not gone into details, perhaps, as fully as I should have done."

A FLORIST at Amsterdam, N. Y., proposes to bring a damage suit against the local Gas Company, alleging that an escape of gas into his greenhouses destroyed flowering plants valued at $1,000. The escape came from a broken street main.

A PETITION has been presented to the Legislature for an act incorporating the Millbury (Mass.) Water and Illuminating Company. Objects, the right to supply water, gas and electricity to the residents of the town. Millbury is in Worcester county, is on the Blackstone river, at a point 6 miles south-southeast of Worcester. It can be reached by way of the Providence and Worcester Railroad, and is on a branch of the Boston and Albany Railroad. It is a well-developed place, and holds not less than 6,000 people.

AT the annual meeting of the Helena (Montana) Gas Light and Coke Company and the Helena Electric Company the following officers were chosen: President, C. W. Cannon; Vice-President, H. M. Parchen, Secretary and Treasurer, H. L. Walker; Superintendent of gas plant, C. M. Williams; Superintendent of electric plant, R. J. Turnbull.

THE proprietors of the Vallejo (Cal.) Gas Light Company are considering the advisability of taking up the supply of electric currents.

CONSTRUCTION work on the gas plant for Bristol, Tenn., is well under way. Bristol has had electric lighting for some time.

THE Board of Gas and Electric Light Commission will, on Friday next, open the hearing on the petition of certain residents of Boston, Mass., for a reduction of gas rates in that city.

AT the annual meeting of the Petersburg (Va.) Gas Light Company the following officers were chosen: President, John G. Dunn; Treasurer, W. F. Spottiswoode; Superintendent, W. H. Baxter.

PRESIDENT JERZMANOWSKI, of the Chicago Gas Light and Coke Company, says the proposition to cut the gas rate in that city to $1 per 1,000 cubic feet amounts virtually to a proposition to confiscate the property of the Company. He also said that the Company would sell gas at $1 per 1,000 if the authorities would guarantee him a stable supply of Pittsburgh gas coal at $1 per ton—he would make no mistake, at that.

## The Market for Gas Securieties.

The city gas share market was abnormally quiet during the week, and the little that was done in Consolidated was at an average of about ¼ per cent. under the quotation of a week ago. To-day (Friday) the bid at opening was 97½, but no stock was offered at less than 98. Equitable scored an advance of 3 points, but holders ask 120. It is worth the money. Mutual is as before. Brooklyn shares show no change. Chicago gas is at 41¾ to 42, with every indication of strength to come. Bay State fell off somewhat, the bid price quoted is 55, while the shares are offered at 58. The hearing on the petition for a reduction in gas rates will soon be underway before the State Commission, and from present indications it is difficult to determine on what ground the Commission can determine in favor of the petitioners. Shareholders in Rochester gas, of all classes, will be pleased to learn that the ridiculous rate war is at an end. Consolidation will probably be effected.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 42 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 cents.

AGENTS.

NEW YORK.—AMERICAN NEWS CO., 39 and 41 Chambers Street.
*Germany.*—B. WESTERMANN & CO., of New York.

MONDAY, FEBRUARY 23, 1891.

## Obituary.—Dr. Otto.

We regret, says *Engineering*, to record the death, at Cologne, on Jan. 26, of Dr. N. Aug. Otto, the inventor of the Otto gas engine. He succumbed after a brief illness. His career exemplifies the success of perseverance and energy paired with skill and ingenuity. Luck often follows pluck, and a false start is not fatal. Mr. Otto started as a commercial traveler, for which duties his great mechanical skill was of little avail. Some circumstances turned his attention to gas engines, where his commercial capacity remained valuable. In 1867 he, in conjunction with Eugene Langen, surprised the engineers who had flocked to the Paris Exhibition, with a real practical gas engine, an engine of the vertical type, with flywheels on the top, not uncanny in appearance, but terribly noisy. The noise had to be borne, and was borne—for the new engine became very popular—for nine years, when the "Otto Silent" was presented. That engine has undergone such manifold improvements by the inventor and by Messrs. Crossley, that startling innovations and perfections are hardly to be looked for.

The gas engine in its practical career has thus quickly attained maturity. Yet the early history of the gas engine has to go back more than 200 years. It is orthodox to quote Huyghens as the first in the field; the series of originators commences, therefore, with one of the best names of physical science. Among the papers of the great physicist is one dated 1640, on a "Novel Motive Force Derived from Gunpowder and Air." Papin took this idea up in 1688, one year after his classical experiment which initiated the steam engine; but he was not satisfied with the results. Fully a century later, Street reopened the researches by bringing out and patenting a motor cylinder with explosion by means of a torch. Many others followed, Lebon, Samuel Brown, Wright, Barnett, Newton, Barsanti and Matteucci, Million, and Lenoir and Hugon, who came very near producing a practical engine.

But Langen and Otto's engine of 1867 was so decidedly superior in the economy of gas consumption that the Lenoir and Hugon engines were at once put out of the field. Otto's gas engine embraced the characteristic features of some of its predecessors—it is rarely otherwise in our days—the compression of Barnett, the cycle of Beau de Rochas, and the free piston and other advantages of Barsanti and Matteucci's engine, which was remarkable in many respects and effected ignition by means of the electric spark. But engineers remain indebted to Dr. Otto for supplying an engine which realized and did what others, who deserve all credit, had been aiming at. We will not here contest the question of priority of invention. It has been fought out many a time; and we believe that no one will begrudge Dr. Otto the benefits and comfort which his work and exertions brought him.

He was an honorable man, esteemed by all who knew him, and his invention was not a lucky hit. He was not trained as an engineer, but he made himself one by hard work and study; and his achievements prove his great theoretical knowledge, mechanical dexterity, and fertility of resources.

## Gas Stocks.

**Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,**

16 WALL ST., NEW YORK CITY.

FEBRUARY 23.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

| | Capital. | Par. | Bid | Asked |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 97½ | — |
| Central | 500,000 | 50 | — | 85 |
| " Scrip | 220,000 | — | 95 | 100 |
| Equitable | 4,000,000 | 100 | 117 | 120 |
| " Bonds | 1,000,000 | — | 113 | 115 |
| Harlem, Bonds | 170,000 | — | — | — |
| Metropolitan, Bonds | 658,000 | — | 110 | 115 |
| Mutual | 3,500,000 | 100 | 116 | 120 |
| " Bonds | 1,500,000 | — | 100 | 102 |
| Municipal, Bonds | 750,000 | | — | — |
| Northern | | 50 | — | — |
| " Bonds | 150,000 | — | — | 100 |
| Standard Gas Co— | | | | |
| Common Stock | 5,000,000 | 100 | — | 48 |
| Preferred | 5,000,000 | 100 | — | 90 |
| Yonkers | | 50 | 112 | — |
| Richmond Co., S. I. | 346,000 | 50 | — | — |
| " Bonds | 20,000 | — | — | — |
| Gas Co's of Brooklyn. | | | | |
| Brooklyn | 2,000,000 | 25 | 116 | 118 |
| Citizens | 1,200,000 | 20 | 85 | 90 |
| " S. F. Bonds | 320,000 | 1000 | 100 | 103 |
| Fulton Municipal | 3,000,000 | 100 | 130 | 132 |
| " Bonds | 300,000 | | 10[illegible] | 105 |
| Peoples | 1,000,000 | 10 | 91 | 92 |
| " Bonds (7's) | 368,000 | — | 100 | — |
| " " (6's) | 94,000 | — | 100 | — |
| Metropolitan | 1,000,000 | 100 | 103 | 105 |
| Nassau | 1,000,000 | 25 | 134 | — |
| " Ctfs | 700,000 | 1000 | 95 | 100 |
| Williamsburgh | 1,000,000 | 50 | 130 | — |
| " Bonds | 1,000,000 | — | 108 | 112 |
| Out of Town Gas Companies. | | | | |
| Boston United Gas Co.— | | | | |
| 1st Series S.F. Trust | 7,000,000 | 1000 | — | 87 |
| 2d " " " | 3,000,000 | 1000 | — | 75 |
| Bay State Gas Co.— | | | | |
| Stock | 5,000,000 | 50 | — | 58 |
| Income Bonds | 2,000,000 | 1000 | 95½ | — |
| Buffalo Mutual, N. Y. | 750,000 | 100 | 90 | 95 |
| " Bonds | 200,000 | 1000 | 95 | 100 |
| Citizens, Newark | 1,000,000 | 50 | 155 | 160 |
| " " Bonds. | 45,000 | — | — | — |
| Chicago Gas Company. | 25,000,000 | 100 | 41¾ | 42 |
| Chicago Gas Light. & Coke Co.— | | | | |
| G't'd Gold Bonds | 7,650,000 | 1000 | 84¾ | 85½ |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1000 | — | 98 |
| People's Gas and Coke Co., Chicago— | | | | |
| 1st Mortgage | 2,100,000 | 1000 | — | 100 |
| 2d " | 2,500,000 | 1000 | 94 | 98½ |
| Consumers Gas Light Co., Jersey City | 2,000,000 | 100 | 12 | 15 |
| Bonds | 600,000 | 1000 | 70 | 75 |
| Cincinnati G. & C. Co. | 6,500,000 | 100 | 204 | 205 |
| Consumers Toronto | 1,000,000 | 50 | 190 | 200 |
| Central, S. F., Cal. | | | 92 | 100 |
| Capital, Sacramento, Cal | | | 58 | |
| Consolidated, Balt. | 11,000,000 | 100 | 47 | 48½ |
| " Bonds | 6,400,000 | | 107 | 107½ |
| Citizens Gas Lt. Co., Rochester, N. Y. | 500,000 | — | 85 | 110 |
| Bonds | 250,000 | | — | — |
| East River Gas Co., Long Island City | 1,000,000 | 100 | 100 | 105 |
| Bonds | 500,000 | 100 | 100 | 102 |
| Hartford, Conn | 750,000 | 25 | 102 | 108 |
| Jersey City | 750,000 | 20 | 165 | 170 |
| Louisville, Ky | 2,570,000 | 50 | 125 | 130 |
| Little Falls, N. Y. | 50,000 | 100 | — | 100 |
| " Bonds | 25,000 | — | 100 | 103 |
| Laclede Gas Light Co., St. Louis, Mo.— | | | | |
| Common Stock | 7,500,000 | 100 | 16½ | 19 |
| Preferred " | 2,500,000 | 100 | 55 | 60 |
| Bonds | 9,034,400 | 1000 | 81 | 81¾ |
| Montreal, Canada | 2,000,000 | 100 | 200 | 208 |
| Memphis (Tenn.) Gas | 750,000 | 100 | 40 | — |
| " Bonds. | 240,000 | 100 | 103 | — |
| New Haven, Conn | | 25 | 200 | — |
| Oakland, Cal | | | 34¼ | 35½ |
| Peoples, Jersey City | | — | 60 | 61 |
| " " Bonds. | | | — | — |
| Paterson, N. J | | 25 | 99 | 102 |
| Rochester, N. Y. | | 50 | 99 | 100 |
| Syracuse, N. Y. | 500,000 | 25 | — | — |
| San Francisco Gas Co. San Francisco, Cal. | 10,000,000 | 100 | 58½ | 59 |
| Washington, D. C. | 2,000,000 | 20 | 200 | 208 |
| Wilmington, Del. | | 50 | 88 | 90 |

## Advertisers Index.

**GAS ENGINEERS.** Page

Jos. R. Thomas, New York City ... 277
Wm. Henry White, New York City ... 283
Fred. Bredel, N. Y. City ... 279

**CHEMISTS.**

Durand Woodman, New York City ... 267

**GAS AND WATER PIPES.**

Gloucester Iron Works, Phila., Pa ... 277
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) ... 277
Ohio Pipe Co., Columbus, Ohio ... 277
M. J. Drummond, New York City ... 277
R. D. Wood & Co., Phila., Pa ... 282
Warren Foundry & Machine Co., New York City ... 277
Donaldson Iron Co., Emaus, Pa ... 277
Dennis Long & Company, Louisville, Ky ... 277
Spiral Weld Tube Company, New York City ... 277

### PROCESSES.


National Gas Light and Fuel Co., Chicago, Ills. 274
Bartlett, Hayward & Co., Baltimore, Md. 281
United Gas Improvement Co., Phila., Pa. 273
Burdett Loomis, Hartford, Conn. 269
American Gas, Light and Heat Co., Phila., Pa. 267


### GAS WORKS APPARATUS AND CONSTRUCTION.


James R. Floyd & Sons, New York City 283
Continental Iron Works, Greenpoint, L. I. 283
Delly & Fowler, Phila., Pa. 283
Kerr Murray Mfg. Co., Fort Wayne, Ind. 280
Stacey Mfg. Co., Cincinnati, Ohio. 283
Bartlett, Hayward & Co., Baltimore, Md. 281
Morris, Tasker & Co., Limited, Phila., Pa. 281
Davis & Farnum Mfg Co., Waltham, Mass. 280
R. D. Wood & Co., Phila., Pa. 282
Bouton Foundry Co., Chicago, Ills. 283
Isbell-Porter Company, New York City. 282
Fred. Bredel, N. Y. City. 279
United Gas Improvement Co., Phila., Pa. 273
National Gas Light and Fuel Co., Chicago, Ills. 274
Berlin Iron Bridge Company, East Berlin, Conn. 268


### INCLINED RETORTS.


Laclede Fire Brick Manuf'g Co., St. Louis, Mo. 272


### GASHOLDER TANKS.


W. C. Whyte, New York City. 274
J. P. Whittier, Brooklyn, N. Y. 275


### GASHOLDER PAINT.


The Government Waterproof Paint Co., Boston, Mass. 268


### RETORTS AND FIREBRICK.


J. H. Gautier & Co., Jersey City, N. J. 278
B. Kreischer & Sons, New York City. 278
Adam Weber, New York City. 278
Laclede Fire Brick Manuf'g Co., St. Louis, Mo. 278
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y. 278
Borgner & O'Brien, Phila., Pa. 278
James Gardner, Jr., Pittsburgh, Pa. 278
Henry Maurer & Son, New York City. 279
Chicago Retort and Fire Brick Co., Chicago, Ills. 278
Baltimore Retort and Fire Brick Co., Baltimore. 278
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo. 278
Boston Fire Brick Works, Boston, Mass. 278


### SCRUBBERS AND CONDENSERS.


G. Shepard Page, New York City. 269
R. D. Wood & Co., Phila., Pa. 282
James R. Floyd & Sons, New York City. 276


### REGENERATIVE FURNACES.


Bartlett, Hayward & Co., Baltimore, Md. 281
Fred. Bredel, New York City. 279
Chicago Retort and Firebrick Co., Chicago, Ills. 278
J. H. Gautier & Co., Jersey City, N. J. 279
Adam Weber, New York City. 270


### GAS GOVERNORS.


Connelly Iron Sponge and Governor Co., New York City. 275
Fred. Bredel, N. Y. City. 279
Friedrich Lux, London, England. 270
Wilbraham Bros., Phila., Pa. 275


### SELF-SEALING MOUTHPIECE DOORS.


Ibsell-Porter Company, New York City. 282
Continental Iron Works, Brooklyn, N. Y. 269


### TAR AND CARBONIC ACID EXTRACTOR.


Geo. Shepard Page, N. Y. City. 269


### CEMENTS.


C. L. Gerould & Co., Brooklyn, N. Y. 278


### GAS ENRICHERS.


Standard Oil Co., Cleveland, Ohio. 284


### GAS METERS.


John J. Griffin & Co., Phila., Pa. 286
American Meter Co., New York and Philadelphia. 287
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa. 287
Helme & McIlhenny, Phila., Pa. 287
D. McDonald & Co., Albany, N. Y. 287
Nathaniel Tufts, Boston, Mass. 286
Maryland Meter and Manufacturing Co., Baltimore, Md. 286
Harris Bros. & Co., Philadelphia, Pa. 286


### EXHAUSTERS.


The P. H. & F. M. Roots Co., Connersville, Ind. 296
Isbell-Porter Company, New York City. 282
Wilbraham Bros., Philadelphia, Pa. 275
Connelly Iron Sponge and Governor Co., New York City. 275


### GAS COALS.


Penn Gas Coal Co., Phila., Pa. 285
Perkins & Co., New York City. 284
Despard Coal Co., Baltimore, Md. 285
Chesapeake and Ohio R. R. Coal Agency, N. Y. City. 285
Westmoreland Coal Company, Phila., Pa. 285
J. & W. Wood, New York City. 284


### CANNEL COALS.


Perkins & Co., New York City. 284
J. & W. Wood, New York City. 284


### VALVES.


Ludlow Valve Manufacturing Co., Troy, N. Y. 268
Chapman Valve Manufacturing Co., Boston, Mass. 268
R. D. Wood & Co., Phila., Pa. 282
The P. H. & F. M. Roots Co., Connersville, Ind. 272


### GAS ENGINES.


Schleicher, Schumm & Co., Phila., Pa. 288
Clerk Gas Engine Co., Phila., Pa. 285
Van Duzen Gas Engine Co., Cincinnati, Ohio. 285


### ENGINES AND BOILERS.


Jarvis Engineering Co., Boston, Mass. 275


### STEAM PUMPS.


Van Duzen & Tift, Cincinnati, Ohio. 268


### GAS LAMPS.


Fiske, Coleman & Company, Boston, Mass. 278


### PURIFIER SCREENS.


John Cabot, New York City. 270


### GAS STOVES.


American Meter Co., New York and Philadelphia. 271
The Goodwin Gas Stove and Meter Co., Phila. Pa. 252
George M. Clark & Company, Chicago, Ills. 270
D. McDonald & Co., Albany, N. Y. 287
Maryland Meter and Manufacturing Co., Baltimore, Md. 286
Chicago Gas Stove Company, Chicago, Ills. 270


### STREET LAMPS.


J. G. Miner, Morrisania, New York City. 268
Bartlett Street Lamp Man'fg Co., New York City. 268


### BURNERS.


C. A. Gefrorer, Phila., Pa. 284
Moses G. Wilder, Phila., Pa. 268


### STEAM BLOWER FOR BURNING BREESE.


H. E. Parson, New York City. 234


### PURIFYING MATERIAL.


Connelly Iron Sponge and Governor Co., New York City. 275
Friedrich Lux, London, England. 270
Hill Chemical Company, Brooklyn, N. Y. 268


### COKE CRUSHER.


C. M. Keller, Columbus, Ind. 285


### ELECTRICAL APPARATUS.


Wm. Henry White, N. Y. City. 283
Fort Wayne Electric Co., Fort Wayne, Ind. 276


### BOOKS, ETC.


1890. Directory, 1890. 275
King's Treatise. 277
Practical Electric Lighting. 275
Electric Light Primer. 275
American Gas Engineer and Superintendents' Handbook. 279
Digest of Gas Law. 270
Fuel and its Applications. 268
Newbigging's Handbook. 279
Scientific Books. 236



## Situation Wanted

**As Superintendent of Gas Works,**

By young man of several years' experience in same. Not particular as to size of works. Best of references. Address

819-2 "A. W.," care this Journal.

## WANTED,

**Position as Superintendent of Gas Works, or Gas and Electric Light Works.**

Ten years' experience. Best of references. Address

819-3 "O. G. W.," care this Journal

## Position Desired

**AS SUPERINTENDENT OF GAS WORKS.**

Either Coal or Water, by a man of many years' experience. Or would lease a works in a city of from 10,000 to 30,000 inhabitants. Best of references. Address

817-4 "W.," care this Journal.

## POSITION DESIRED

**As Superintendent of Gas Works,**

By a young man fully experienced in the details of construction, manufacture, and distribution. Best of references. Address

814-tf "CONSTRUCTION," care this Journal.

## WANTED,

Second-Hand Roots Exhauster, No. 3.

With Valves and 6-inch Connections, in good order. Address

817-13 "EXHAUSTER," care this Journal.

## FOR SALE,

**One Air Condenser,** 500,000 feet capacity.
**One Multitubular Condenser,** 500,000 feet capacity.
**One Anderson Tar Extractor,** 500,000 feet capacity.
**Ten 12-inch Chapman Valves.**
**One Station Meter (Tufts'),** 40,000 feet capacity.
**Seventy-Five 12-inch by 20-inch Mouthpieces,** with Balmore's Self-Sealing Lids.

All in good order. Address NEW HAVEN GAS LT. CO., 819-tf New Haven, Conn.

## DURAND WOODMAN, Ph.D.,

**Analytic and Technical**

## CHEMIST.

Analyses of Gas, Fuel and Gas Coals, Crude and Refined Petroleum, Materials for Gas Purification, Tar, Ammoniacal Liquors and other Bye-Products, Fire Clays, Deposits in Mains, Water for Steam Making, Boiler Scale, etc., etc. Expert work in connection with "Damages to adjacent water supplies and adjoining properties." Experimental Investigations for Inventors.

**127 Pearl Street (Hanover Square), N. Y.**

## The American Gas, Light & Heat Co.,

OF

**249 S. 6th St., Phila., Pa.,**

Are now prepared to erect plants of their Oxy-Hydrocarbon Process, to carburet coal gas up to any given or named candle power required for general consumption (for instance, from 20 to 25 candles), and at a cost not to exceed one and three-quarters (1¾) cents per candle power per 1,000 cubic feet increased, with a permanent and perfectly *fixed* gas, *not a vapor*—a gas that will whiten the whole output of the works.

This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

Our system is such that we can furnish plants that will carburet 50,000 cubic feet in 24 hours, or three or four million feet in the same length of time. *One* of our large benches or plants would be capable of generating 100,000 cubic feet of gas in 24 hours, which would raise the candle power on 2,000,000 feet (taking as a standard coal gas at 15 candles) 3 candles on the 2,000,000 feet, enabling the works to deliver to consumers an 18 candle gas; or, enlarging our plant, the candle power may be increased as desired, at the same cost per candle power, less interest on plant.

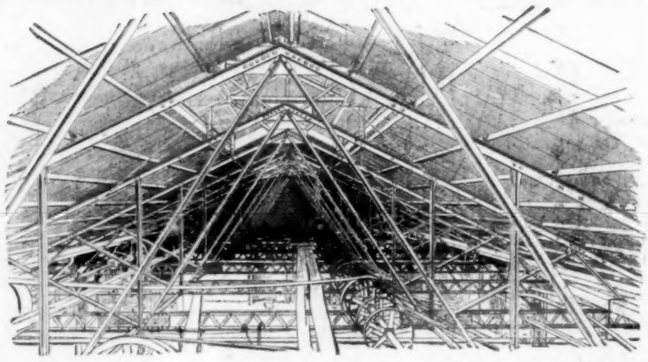
This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor. Correspondence solicited.

**J. J. NEWELL, Sec'y.**

**September 4, 1890.**

# THE BERLIN IRON BRIDGE CO.

Write for Illustrated Catalogue.



Write for Illustrated Catalogue.

This illustration is taken direct from a photograph of an iron building built by us for the Franklin Moore Company, at Winsted, Conn. The building is entirely of iron, not a particle of woodwork being found anywhere in its construction. The photograph is taken from the roof in order to show the arrangement for carrying the gears, shafting, etc. The trusses are connected by iron purlins, and the whole building is covered with corrugated iron.

Office and Works, EAST BERLIN, CONN.

Agencies: WM. PAYSON, San Antonio, Tex. M. B. GRANT, Enterprise, Miss. W. E. STEARNS, Omaha, Neb. A. M. RAWN, Dayton, Ohio.

# GASHOLDER PAINT.

Use Only

THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO., 122 Milk Street, Boston, Mass.

## The Miner Street Lamps.

## Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y

## Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY.

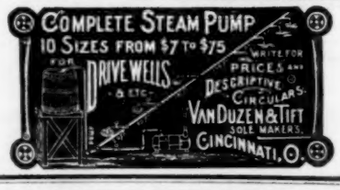
Gas Companies and others intending to erect Lamps and Posts will do well to communicate with us.

## Fuel and Its Applications.

By E. J. MILLS, D.Sc. F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

7 PLATES, AND 607 OTHER ILLUSTRATIONS. ROYAL OCTAVO, PAGES XX, 802. HANDSOME CLOTH, $7.50.

A. M. CALLENDER & CO., 42 Pine St., N. Y.


COMPLETE STEAM PUMP
10 SIZES FROM $7 TO $75
FOR DRIVE WELLS & ETC.
WRITE FOR PRICES AND DESCRIPTIVE CIRCULARS
VAN DUZEN & TIFT
SOLE MAKERS
CINCINNATI, O.

## CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants With and Without Independent Nozzle Valve. All Work Guaranteed.

WORKS & GEN'L OFFICE: Indian Orchard, Mass.

TREASURER'S OFFICE: 72 Kilby & 112 Milk Sts, Boston, Mass.

"SUCCESSFULLY INTRODUCED."

## Hill Chemical Company's

# IRON MASS

For Gas Purification.

Office, 229 Bridge Street. Works, Newtown Creek.

BROOKLYN, N. Y.

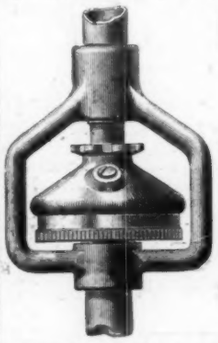
CORRESPONDENCE SOLICITED.

## MOSES G. WILDER, MECH. ENGR.

816-18-20-22 Cherry St., Phila., Pa.

## Volumetric Lamp Governors

FOR GAS LAMPS & HIGH-POWER BURNERS.



GOVERNOR BURNERS

for

STREET LAMPS AND GENERAL USE,

and

GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

HORIZONTAL

Governors

Specially adapted for GAS STOVES, FURNACES, Etc., Etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

*Correspondence Solicited with all who require a Reliable Governor.*

## LUDLOW VALVE MFG. CO.

OFFICE AND WORKS,

938 to 954 River Street and 67 to 83 Vail Av.,

TROY, N. Y.

Hydraulic Main Dip Regulators, also Check Valves, Foot Valves, Yard-wash and Fire Hydrants.

Send for Circulars.

Valves.—Double and Single Gate, ¾ in. to 48 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, and Oil.

Send for Circulars.

# SELF-SEALING RETORT MOUTHPIECE AND LID.

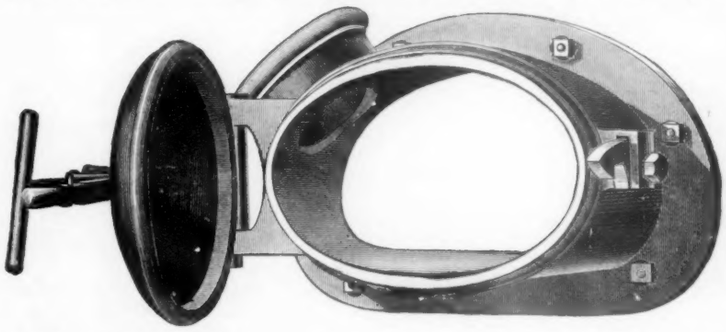
MANUFACTURED SOLELY BY

## The Continental Iron Works

THOS. F. ROWLAND, President.

Take 10th or 23d Street Ferries from New York to Greenpoint. **BROOKLYN, N. Y.**

Made for Round, Oval, or "D" Retorts.



Joint made under the well-known Balmore Patent

This Mouthpiece and Lid was introduced to the public in 1884, and since then large numbers have been manufactured and sold.

The following important Gas Companies have them in use at the present time, to any of which we refer:

**Charleston (S. C.) Gas Light Company.**
**Williamsburgh (Brooklyn, N. Y.) Gas Light Co.**
**Bridgeport (Conn.) Gas Light Company.**
**Buffalo Mutual Gas Light Company.**
**Palatka (Fla.) Gas Light Company.**
**Gainesville (Fla.) Gas Light Company.**
**Syracuse Gas Light Company.**
**Taunton (Mass.) Gas Light Company.**
**Providence Gas Light Company**
**Central (New York City) Gas Light Company.**
**Northern (New York City) Gas Light Company.**
**Stamford (Conn.) Gas Light Company.**
**Holyoke (Mass.) Gas Light Company.**
**Springfield (Mass.) Gas Light Company.**

KIRKHAM, HULETT & CHANDLER'S NEW PATENT

# "Standard" Washer-Scrubber.

**Extracts the Whole of the Ammonia and a Large Percentage of the Sulphureted Hydrogen and Carbonic Acid.**

**MINIMUM WEIGHT IN MOTION • MINIMUM DRIVING POWER • MINIMUM BACK PRESSURE • MINIMUM WEAR AND TEAR • WITH MAXIMUM RESULTS.**

The "New" Washer-Scrubber, with Wooden "Bundles," has been for many months in successful operation at the London Gas Light and Coke Company's station at Beckton, and at many other European Gas Works
The "Bundles" can be supplied to "Standard" Washer-Scrubbers already in use.

**GEO. SHEPARD PAGE, Sole Agt. for Western Hemisphere, 69 Wall St., New York.**

# Water Gas! Fuel Gas!

For all Manufacturing Purposes. Generated from Bituminous Slack, Anthracite Coal Dust, or Coke Breeze, by

# THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Sons' Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Utilizing any Kind of Low-Priced Coals.

NOVEL IN DESIGN, MODERN IN CONSTRUCTION, SIMPLE IN OPERATION, PERFECT IN RESULTS.

Plans and Estimates Furnished.

**BURDETT LOOMIS, - - Hartford, Conn.,**

**Or Murray Hill Hotel, New York City.**

## MANHATTAN FIRE BRICK AND ENAMELED CLAY RETORT WORKS.

# ADAM WEBER, Prop'r,

633 East Fifteenth St., N. Y.

# Modern Recuperative Furnaces

FOR FIRING COAL GAS AND FIXING BENCHES, ALSO INCLINED AND VERTICAL RETORTS.

The most successful Furnace in America in competition with all others. Results equalled by no other Furnace, Full or Semi-Regenerative. Superior to all others in strength of construction and prolonged life of Retorts and Furnace.

## PATENTS.

FRANKLIN H. HOUGH

Solicitor of American & Foreign Patents.

925 F. ST., WASHINGTON, D. C.

(NEAR U. S. PATENT OFFICE.)

Personal attention given to the preparation and prosecution of applications for Letters Patent. All business before the U. S. Patent Office attended to for moderate fees. **No Agency in the United States possesses superior facilities for obtaining Patents,** or for ascertaining the patentability of inventions. Copies of patents furnished for 25 cents each. Correspondence solicited.

## GREENOUGH'S "DIGEST OF GAS LAW."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every ga company in the country, whether large or small As a book of reference it will be found invaluable It is the only work of the kind which has eve been published in this country, and is most com plete. Handsomely bound. Orders may be sent t

J. M. CALLENDER & CO., 42 Pine St., N. Y.

SPECIAL TRAYS FOR IRON SPONGE OR OXIDE OF IRON.

## CHURCH'S TRAYS A SPECIALTY.

REVERSIBLE-STRONGEST-MOST DURABLE-MOST EASILY REPAIRED.

JOHN CABOT. TRAYS FOR GAS WORKS.

306-310 ELEVENTH AVENUE, NEW YORK.

WE ALSO MAKE THE CHEAPEST AND STRONGEST REVERSIBLE BOLTED TRAYS IN THE MARKET.

## CHICAGO GAS STOVE CO.

MANUFACTURERS OF ALL KINDS OF

## Gas Cooking and Heating APPLIANCES.

240, 242 & 244 West Lake St., Chicago.

Send for Catalogue.

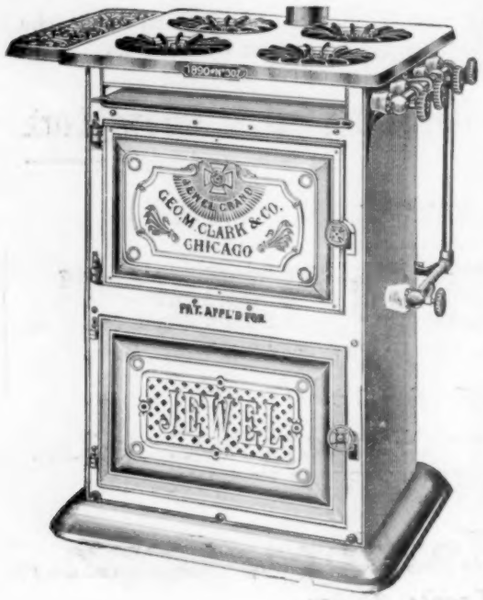
## FRIEDRICH LUX,

Ludwigshafen am Rhein and London.

Lux Mass

GAS GOVERNORS,

Gas Balance.




## JEWEL GAS STOVES

MANUFACTURED BY

GEORGE M. CLARK & COMPANY,

157 & 159 Superior Street, - Chicago, Ill.

EVERY CONCEIVABLE SIZE AND STYLE.

Ranging in Prices from $1.50 to $37.00.

WE USE NO GAS COCKS.

All Flames are Regulated by a Direct Needle Valve.

The JEWEL

IS THE

Only Well-Made Gas Stove on the Market.

Write for our 1890 Catalogue and see for yourself.

Jewel Circulating Water Heater. $15.00.

GAS STOVES. GAS METERS. GAS STOVES.

# THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

MANUFACTURERS OF

Standard 3 Diaphragm Dry Meter.

## Gas Meters,

**STATION METERS,**

METER PROVERS, PHOTOMETERS,

Experimental Meters of all Kinds,

AND

Standard 2 Diaphragm Dry Meter.

## Apparatus for Testing the Quantity and Quality of Gases.

## Meters for Measuring Natural Gas.

MANUFACTORIES,

508 to 514 West Twenty-second St., N. Y. Arch and Twenty-second St., Phila.

Nos. 244 & 246 North Wells Street, Chicago, Ill.

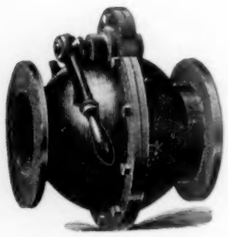
AGENCIES,

No. 177 Elm Street, Cincinnati, Ohio. No. 222 Sutter Street, San Francisco, Cal.

No. 810 North Second Street, St. Louis, Mo.

**GAS STOVE SHOW ROOMS, No. 242 Sixth Avenue, New York City.**

# ROOTS'
# GAS AND BYE-PASS VALVES.



**GAS VALVE**

Quick Acting,
Simple,
Efficient, Durable.

**BYE-PASS VALVE.**

Automatic Action
Reliable
Simple Durable.

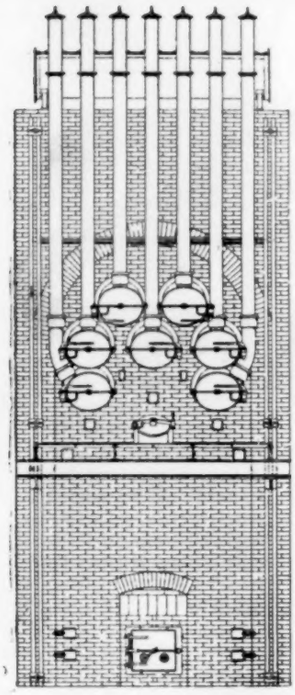
Thousands now in use and giving perfect satisfaction. Write for Catalogue and Prices.

**Send for Descriptive Catalogue and Price List.**

**THE P. H. & F. M. ROOTS CO.,** Patentees and Manufacturers, **CONNERSVILLE, IND.**

S. S. TOWNSEND, Gen. Agt., 22 Cortlandt St., N. Y. COOKE & CO., Selling Agts., 22 Cortlandt St., N. Y.

# LACLEDE FIRE BRICK MANUFACTURING COMPANY,



**ST. LOUIS, MO.**

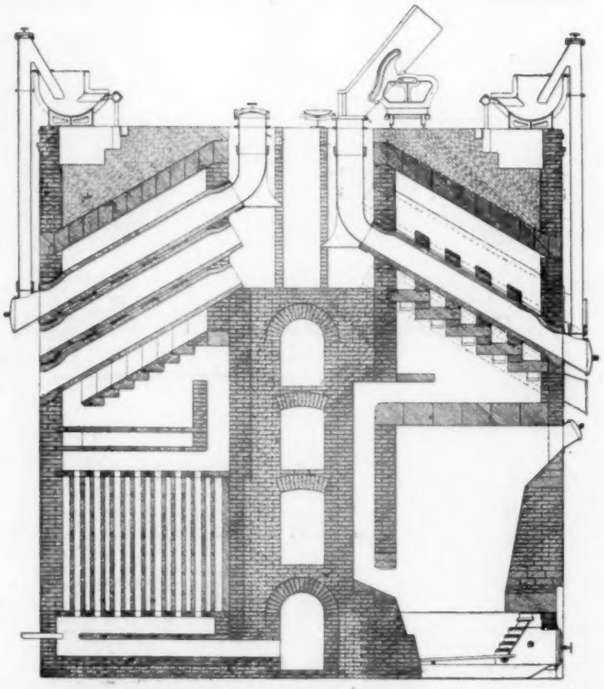
Exclusive Agents in the United States

FOR THE

## Coze System of Inclined Retorts.

IT IS THE COMING BENCH FOR MAKING COAL GAS.

*It will Save from 50 to 60 per ct. in Labor.*



ESTIMATES AND PLANS FURNISHED BY THE

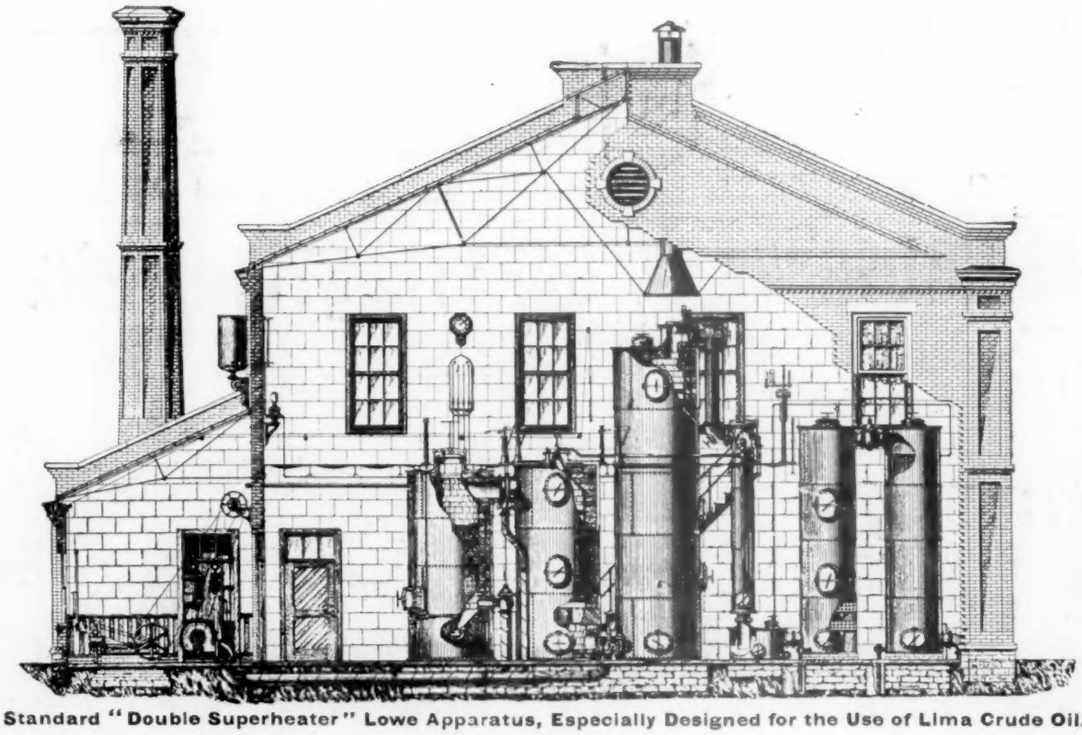
# LACLEDE FIRE BRICK MFG. CO., ST. LOUIS, MO.

# THE UNITED GAS IMPROVEMENT CO.,

## DREXEL BUILDING, PHILA., PA.

Owners of the Lowe, Granger-Collins, McKay-Critchlow (for carbureting Natural Gas), and Other Gas Patents.

## BUILDERS, LESSEES and PURCHASERS OF GAS WORKS.



Standard "Double Superheater" Lowe Apparatus, Especially Designed for the Use of Lima Crude Oil.

Erectors of

## WATER GAS PLANTS,

(Either Independent or Auxiliary to Coal Gas Works),

**USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE.**

PAMPHLETS, PLANS, AND ESTIMATES FURNISHED UPON APPLICATION.

# NATIONAL GAS LIGHT AND FUEL CO.,

**218 La Salle Street, Chicago.**

C. D. HAUK, Prest. & Gen'l Manager. A. W. GREEN, Vice-Prest. N. A. McCLARY, Sec. & Treas. E. E. MORRELL, Engr.

# GAS WORKS

**Built, Remodeled, Leased, and Purchased.**

71 Springer Cupolas have been installed in the U. S. during the past four years.

The total capacity of Springer Apparatus now in use is over 25,000,000 ft. daily.

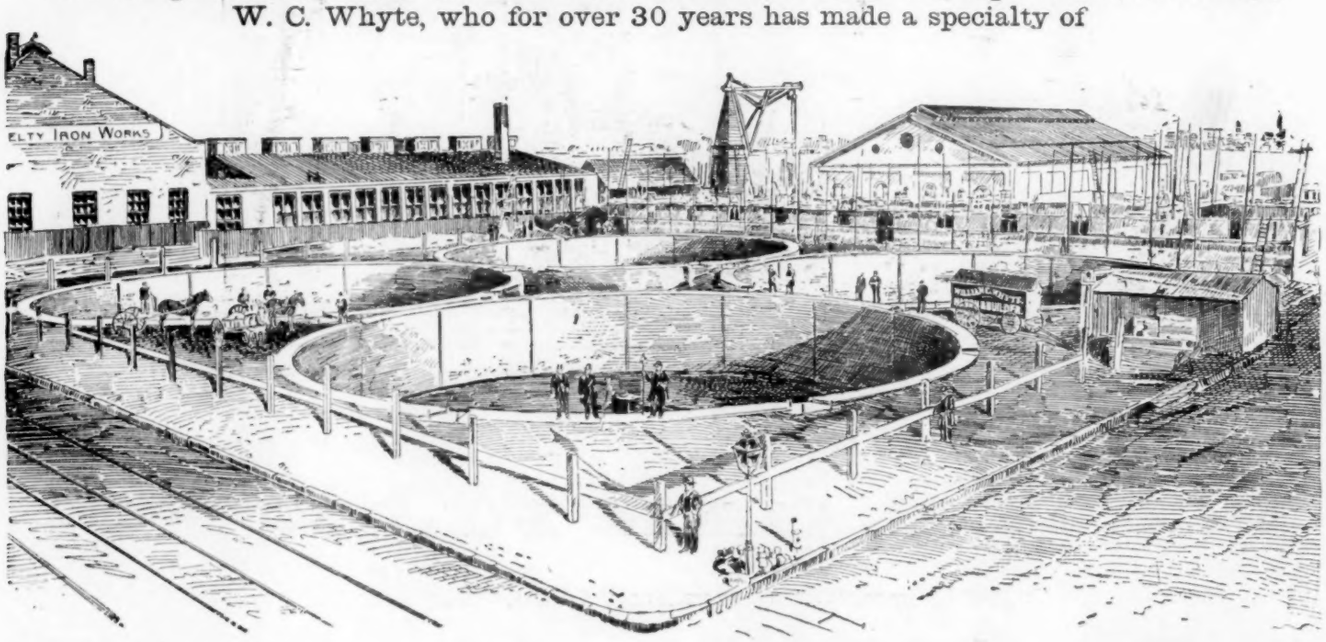
## THE SPRINGER CUPOLA SYSTEM

Has Proven Itself the most Economical and Satisfactory Method of Gas Manufacture ever brought to the attention of the Gas Fraternity.

**GUARANTEED ESTIMATES of Cost of Gas Furnished on Application.**

## GASHOLDER TANK CONSTRUCTION, ETC.

Gas Companies and others about to erect Gasholders will find it profitable to consult W. C. Whyte, who for over 30 years has made a specialty of




## Tank Excavation and Mason Work.

Fifty Tanks now in operation show the sort of work done. Address

**W. C. WHYTE, - No. 15 Cortlandt Street, N. Y. City.**

# CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

**"IRON SPONGE."** Saves money, saves labor, and is the most efficient purifying agent ever offered as a substitute for lime. Now used *in every State in the Union*, and purifying daily over *thirty-five million cubic feet.* Should be used in every gas works. Its own saving will pay for it many times over.

**AUTOMATIC GOVERNOR.** Has been on the market but *three years*, and in that time has been introduced *more generally* than any invention ever designed for use in gas works. Over *three hundred* of them now in use. Sensitive; reliable; perfectly automatic; reduces leakage; satisfies consumers, and gives great relief to the Manager. No gas works is *complete* without one of these machines.

**STEAM JET EXHAUSTER.** Designed particularly for small works Combines Exhaust Tube, Steam Governor Gas Compensator, and Bye-Pass Valves in the most compact form possible; occupies but little space; uses very little steam; operated by ordinary workmen; saves formation of carbon in retorts; increases yield 10 to 15 per cent. Specially adapted for *mixing air* with oil gas. *No works* too small to use them profitably.

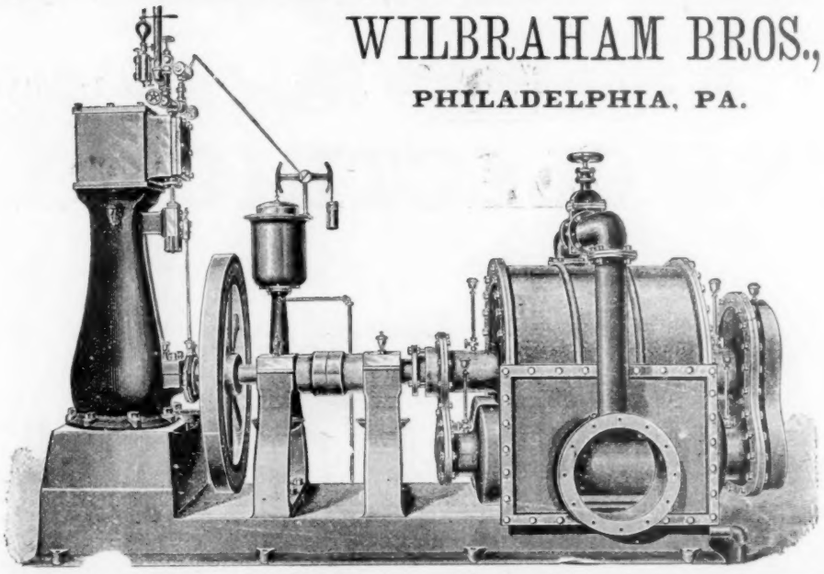
Prices given on all our specialties *delivered at any point in the United States.* Correspondence solicited.

**CONNELLY IRON SPONGE AND GOVERNOR CO., No. 111 Broadway, New York.**

## WILBRAHAM
## GAS EXHAUSTER & ENGINE COMBINED.

WILBRAHAM BROS.,

PHILADELPHIA, PA.



## JARVIS ENGINEERING CO.,

61 Oliver St., Boston, Mass.

CONTRACTORS FOR ERECTING

**COMPLETE STEAM OUTFITS FOR ELECTRIC LIGHTING STATIONS.**

Steel Boilers set with Jarvis Pat. Boiler Setting

To burn **COKE SCREENINGS** for Fuel.

ARMINGTON & SIMS CO. ENGINES,

Belting direct to Dynamos, without using Shafting.

**SEND FOR CIRCULARS.**

REFERENCES.—Charlestown Gas & Electric Light Co., Charlestown, Mass.; Schenectady Gas & Electric Light Co., Schenectady N. Y.; Brookline Gas Co., Brookline, Mass.

## Practical Electric Lighting.

By A. BROMLEY HOLMES, A.M.I.C.E.

With 87 Illustrations. Third Edition. **Price, $1.00.**

## Electric Light Primer.

By CHARLES L. LEVEY.

A simple and comprehensive Digest of all the most important facts connected with the running of the Dynamo and Electric Lights, with Precautions for Safety, etc.

**Price, 50 cents.**

A. M. CALLENDER & CO., 42 Pine St., N.Y.

# Gasholder Tanks & Gas Works Masonry Complete.

PLANS PREPARED AND ESTIMATES FURNISHED AT SHORT NOTICE.

**J. P. WHITTIER, 70 Rush St., near Division Av., Brooklyn, N. Y.**

**A Large Quantity of Ground Fire Brick For Sale Cheap.**

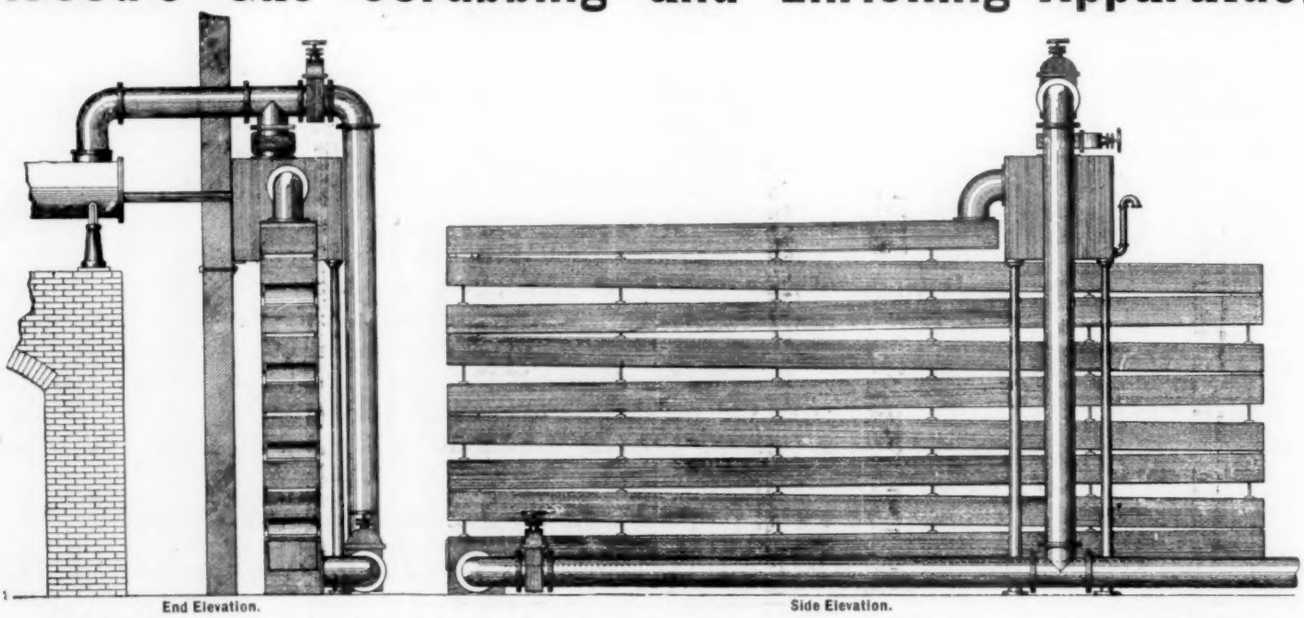
# 1890 DIRECTORY 1890

**OF THE GAS LIGHT COMPANIES of the UNITED STATES & CANADA.**

**Price, . . . . . $5.00.**

**A. M. CALLENDER & CO., No. 42 Pine Street, N. Y. City.**

# Wood's Gas Scrubbing and Enriching Apparatus.



End Elevation. Side Elevation.

The cheapest, simplest, and most effective apparatus for removing Tar and Ammonia, and enriching Gas, ever brought to the attention of Gas Manufacturers. With ordinary condensers and scrubbers the condensable illuminants flow off to the tar wells and liquor tanks and are lost, but with Wood's Apparatus these illuminants are saved and retained in the gas, thus increasing its illuminating power and making a great saving in the cost of enriching material. Where set up next after the Hydraulic main, this Scrubber produces an 8-oz. Ammoniacal Liquor.

**JAMES R. FLOYD & SONS, - - Nos. 531 to 543 West 20th Street, N. Y. City.**

# FORT WAYNE ELECTRIC CO.

FORT WAYNE, IND.

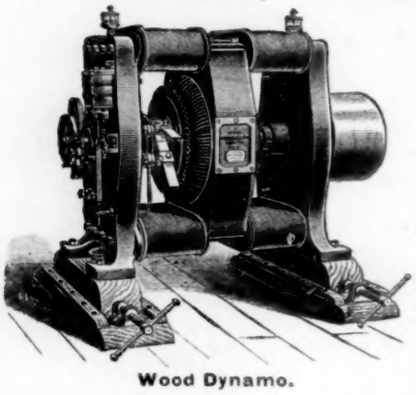
MANUFACTURERS OF THE

## Slattery Induction System

—OF—

# LONG DISTANCE INCANDESCENT LIGHTING.

The Most Carefully Worked Out and Complete Alternating Current System of Electric Lighting in Existence.



Wood Dynamo.

— AND THE —

## WOOD

Automatically Regulating

***ARC DYNAMOS and LAMPS.***

Main Office, - - - Fort Wayne, Indiana.

Factories: Fort Wayne, Ind.; Brooklyn, N. Y.

**BRANCH OFFICES.**

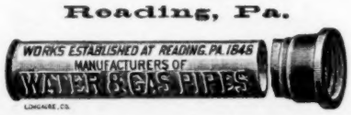
| | |
|---|---|
| NEW YORK, - - - - - - 115 Broadway. | DETROIT, MICH., - - - 57 Gratiot Avenue. |
| PHILADELPHIA, - - - - - 907 Filbert Street. | TORONTO, CANADA, - - 138 King Street, West. |
| CHICAGO, - - - - 185 Dearborn Street. | MEXICO, F. Adams' Successors, - - City of Mexico. |
| SAN FRANCISCO, - - 35 New Montgomery Street. | CUBA, Maicas & Co., - - - - - Havana. |

ENGINEERS. GAS AND WATER PIPES. GAS AND WATER PIPES.

P. D. WANNER, Chairman. A. H. MELLERT, Mangr. of Wks.
R. B. KINSEY, Secretary. F. A. KNOPP, Treasurer.

## MELLERT FOUNDRY & MACHINE CO. Ltd. and READING FOUNDRY CO., Ltd.

**Reading, Pa.**




**Specials—Flange Pipe, Valves and Hydrants Lamp Posts, Retorts, etc.**

General Foundry and Machine Work.

**JOHN FOX,** Selling Agent. **160 Broadway, N.Y.**

## THE OHIO PIPE COMPANY,

MANUFACTURERS OF

## Cast Iron Gas & Water Pipe,

**BRANCH AND SPECIAL CASTINGS.**

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

**GENERAL FOUNDERS AND MACHINISTS.**

**Columbus, Ohio.**

## M. J. DRUMMOND,

**SPECIAL CASTINGS AND LAMP POSTS.**

Office, Corbin Building, 192 Broadway, N. Y.

## EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

MANUFACTURERS OF

**CAST IRON PIPE AND SPECIAL CASTINGS**

FOR WATER AND GAS.

## JOS. R. THOMAS,

**No. 42 Pine Street, N.Y. City.**

**CONSULTING AND CONSTRUCTING**

## Gas Engineer and Contractor.

PLANS, SPECIFICATIONS, AND ESTIMATES FURNISHED.

**Contracts taken for all Appliances required at a Gas Works,**

Either for New Works or Extensions to Old Plants.

SAM'L R. SHIPLEY, Pres. JAS. P. MICHELLON, Sec.
HENRY B. CHEW, Tr WM. SEXTON, Supt.

## GLOUCESTER IRONWORKS,

GLOUCESTER CITY, N. J.

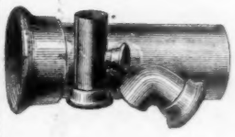
## Cast Iron Gas & Water Pipes, Stop Valves, Fire Hydrants, Gasholders, &c.

**Office, Rooms 703 & 704, Provident Bldg., 401 Chestnut St., Phila., Pa.**

## WARREN FOUNDRY AND MACHINE CO.,

**Established 1856. Works at Phillipsburgh, N. J.**

**New York Office, 160 Broadway.**



## CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

**Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.**

## DENNIS LONG & COMPANY,

**LOUISVILLE, KY.,**

**Manufacture Exclusively**

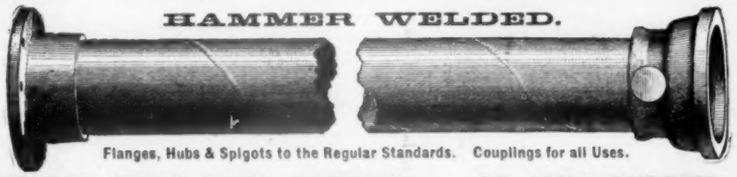
## CAST IRON GAS & WATER PIPE & SPECIAL CASTINGS

OF ALL SIZES.

## SPIRAL WELD STEEL PRESSURE TUBES.

**HAMMER WELDED.**

Best Gas Pipe Made



Strong, Light, Cheap

**Flanges, Hubs & Spigots to the Regular Standards. Couplings for all Uses.**

**THE SPIRAL WELD TUBE COMPANY, - 43 JOHN STREET, N. Y.**

## King's Treatise on Coal Gas.

**In 3 Vols. Price per Vol., $10. Sold either by Volume or in Sets.**

**A. M. CALLENDER & CO., 42 Pine St., N. Y.**

RETORTS AND FIRE BRICK.

**J. H. GAUTIER & CO.,**

CORNER OF

**GREENE AND ESSEX STREETS,**

*JERSEY CITY, N. J.*

MANUFACTURERS OF

**Clay Gas Retorts,**

**Gas House Tiles,**

**Fire Bricks, Etc. Etc.**

**Ground Clay, Fire Brick and Fire Sand in Barrels,**

J. H. GAUTIER. C. E. GREGORY. C. E. GAUTIER.

**BROOKLYN**

**Clay Retort & Fire Brick Works,**

(EDWARD D. WHITE & CO.)

**Manufacturers of Clay Retorts, Fire Brick, Gas House and other Tile.**

VAN DYKE, ELIZABETH, RICHARDS & PARTITION STS.

**Office, 88 Van Dyke St., Brooklyn, N. Y.**

RETORTS AND FIRE BRICK.

**LACLEDE FIRE BRICK MFG. CO.,**

MANUFACTURERS OF

**Fire Brick, Gas Retorts,**

AND

**ST. LOUIS STANDARD SEWER PIPE.**

Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.

OFFICE AND DEPOT

**901, 903, and 905 Pine Street, ST. LOUIS, MO.**

ESTABLISHED IN 1845.

**B. KREISCHER & SONS,**

OFFICE FOOT OF HOUSTON ST., E.R., N.Y.

**Gas Retorts,**

*TILES, FIRE BRICK.*

**AND EVERYTHING IN THE FIRE CLAY LINE.**

RETORTS AND FIRE BRICK.

**MANHATTAN**

**FIRE BRICK & ENAMELLED CLAY**

**RETORT WORKS**

**ADAM WEBER.**

**CLAY GAS RETORTS AND RETORT SETTINGS FIRE BRICKS, TILES, ETC.,**

Office and Works, 15th Street and Avenue C., N. Y

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

**JAMES GARDNER, JR.,**

Successor to WILLIAM GARDNER & SON.

Office, Rooms 19 & 20, Lewis Block PITTSBURGH, PA. P. O. Box 373

**Fire Clay Goods for Gas Works.**

**SOLE REPRESENTATIVE OF THE McILHENNY RECENERATIVE BENCHES FOR THE U. S.**

H. A. NORTON, No. 92 WATER STREET, BOSTON, MASS., Agent for the New England States.

GEO. C. HICKS, Prest. **CHICAGO** CHAS. A. REED, Sec. & Treas.

**Retort and Fire Brick Co.,**

MANUFACTURERS OF

**Fire Clay Goods of all Kinds,**

AND BEST QUALITY ONLY.

**Regenerative Furnaces & Water Gas Goods.**

**45th St., Clark to La Salle, Chicago.**

**GEROULD'S IMPROVED RETORT CEMENT.**

A Cement for patching retorts, putting on mouthpieces, and making up all bench-work joints. This Cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick. For recommendations and price list address

**C. L. GEROULD & CO.,**

**5 & 7 Skillman St., Brooklyn, N. Y.**

Western Agent, H. T. GEROULD, Mendota, Ill.

**Parker-Russell Mining and Mfg. Co.,**

**CITY OFFICE,**

Mermod-Jaccard Bldg., Rooms 307 & 308, Broadway & Locust St., St. Louis, Mo.

PROPRIETORS OF THE

**OAKHILL GAS RETORT & FIRE BRICK W'KS**

Our immense establishment is now employed almost entirely in the manufacture of

**Materials for Gas Companies**

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnaces, and the abrasion of feeding and emptying. We have the *exclusive Agency for the West* of the celebrated

**Kloenne-Bredel Full Depth and Semi-Recuperator Benches,**

And also furnish and build

**Our Own Styles Semi-Recuperator Furnaces for the use of Coal or Coke as fuel.**

THOS. SMITH, Prest. AUGUST LAMBLA, Vice-Prest. & Supt.

**BALTIMORE**

**RETORT & FIRE BRICK CO.**

MANUFACTORY AT

**LOCUST POINT BALTIMORE, MD.**

**Clay Retorts, Blocks & Tiles**

**FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.**

**Red and Buff Ornamental Tiles and Chimney Tops. Drain and Sewer Pipe (from 2 to 30 inches). Baker Oven Tiles 12 x 12 x 2 and 10 x 10 x 2.**

WALDO BROS., 88 WATER ST., BOSTON, MASS

Sole Agents the New England States.

**Boston Fire Brick Works** Manufacturers of **Gas Retorts and Settings**

Under the Personal Supervision of MR. GEO. C. HICKS late of Chicago.

Fire Clay Goods of all kinds. Akron Sewer Pipe, Lime, Cement, etc. Agts. for the Arc Gas Lamp & Governing Gas Burners.

Send for Circulars and Prices to

**FISKE, COLEMAN & CO., Managers, No. 62 Congress Street, Boston, Mass.**

# FRED. BREDEL, C. E.,

## Contractor for the Complete Erection and Equipment of Gas Works.

Sole Proprietor of the KLOENNE PATENTS for North America.

### Gas Condensing and Purifying Machine.

Doing all the Work Between Exhauster & Oxide Purifier.

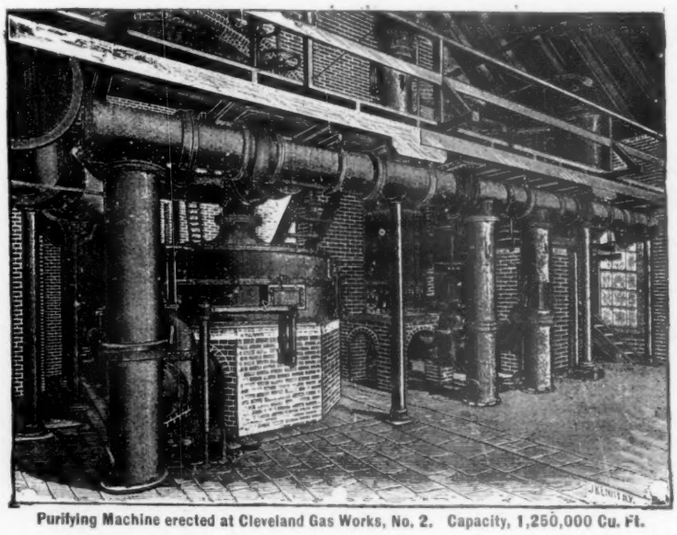
No Condensers Required.

**No Naphthaline or Pitch is Formed.**

HIGHER CANDLE POWER.

### Tar & Ammonia Washers

**WATER GAS WASHERS.**



Purifying Machine erected at Cleveland Gas Works, No. 2. Capacity, 1,250,000 Cu. Ft.

### RECUPERATIVE FURNACES.

Adapted to Retort Houses With or Without Stage Level.

Over 1,400 Retorts Now in Use in America.

### Inclined Retort Benches.

Refers, by permission, to Mr. Eugene Vanderpool, Newark, N. J., and Mr. E. G. Cowdery, Milwaukee, Wis.

For further information address

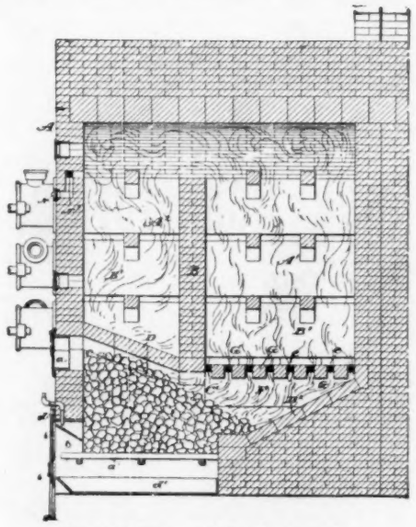
## FRED. BREDEL,

No. [illegible] Seventeenth Street, - - - - New York City.

---

FLEMMING'S

## Generator-Gas Furnace



Materials furnished and Benches erected by

**J. H. GAUTIER & CO., - Jersey City, N. J.**

Address as above, or D. D. FLEMMING, Jersey City, N. J.

---

## HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

## RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y.

**Clay Gas Retorts,**

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

---

## THE NEW HANDY BINDER.

This article may be described as elegant in appearance, strong, durable, and possessing many special qualities of its own. It allows the opening of the pages perfectly flat, whether one or several numbers are in the binder. Any number can be taken out and replaced without disturbing the others. The papers are not mutilated for subsequent binding in permanent form. The binder is supplied with gilt side title, and is an ornament to any desk or reading table. The JOURNAL, filed in the Handy Binder, becomes a volume of great value, always convenient for instant reference. **Handy Binder, Postage paid. $1 00.**

A. M. CALLENDER & CO., 42 PINE STREET, NEW YORK CITY.

---

# The American Gas Engineer and Superintendent's Handbook.

**By WILLIAM MOONEY.**

Consisting of Rules, Reference Tables, and Original Matter Pertaining to the Manufacture, Manipulation, and Distribution of Illuminating Gas.

350 Pages, Full Gilt Morocco. Price, $3.

**A. M. CALLENDER & CO., 42 Pine St., N. Y.**

---

## NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text, and much of it has been rewritten and otherwise improved. Price, cloth, $6.

A. M. CALLENDER & CO., 42 Pine St. N. Y.

# DAVIS & FARNUM MFG. CO.,

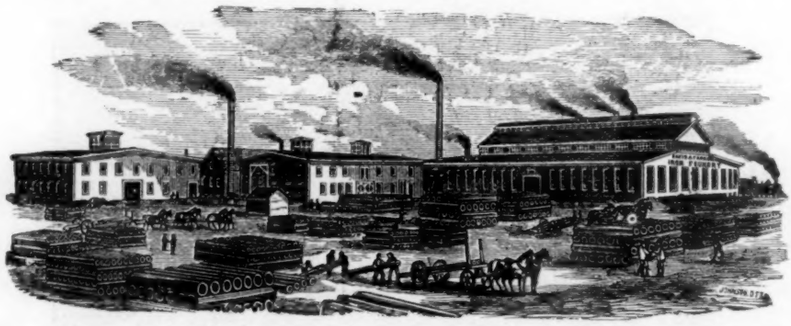
## WALTHAM, MASS.

PRINCIPAL OFFICE AND WORKS, Waltham, Mass. BOSTON OFFICE, Room 18, Vulcan Building, 8 Oliver Street.

SINGLE, DOUBLE, AND TRIPLE LIFT

**Gasholders.**

OF ANY CAPACITY.



TUBULAR, PIPE, AND SINUOUS FRICTION

**Condensers.**

OF ALL SIZES.

IRON ROOF FRAMES AND FLOORS.

**Purifying Boxes, Center Seal or Valve Connections, Bench Work.**

**Reversible Lime Trays.**

SELF-SEALING AND PRESSED STEEL MOUTHPIECE LIDS.

**Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Plant.**

— ALSO —

**Gas and Water Pipe, Flanged Pipe,**

Sugar House Work, and Special Castings of all Descriptions.

---

Established 1861. Incorporated 1881.

# KERR MURRAY MFG. CO.,

## FORT WAYNE, IND.

Those who are in need of

**Holders or Gas Works Apparatus of any Description,**

AND OF THE LATEST IMPROVEMENTS,

will find it to their interest to

**GET AN ESTIMATE FROM US**

before placing their order.

**As we make a Specialty of this Class of Work, and are Practical Builders and Manufacturers of same,**

with our long years of experience in the business,

**WE CAN GUARANTEE YOU SATISFACTION.**

Estimates, Plans and Specifications Furnished on Application.

# BARTLETT, HAYWARD & CO.

**Baltimore, Md.**

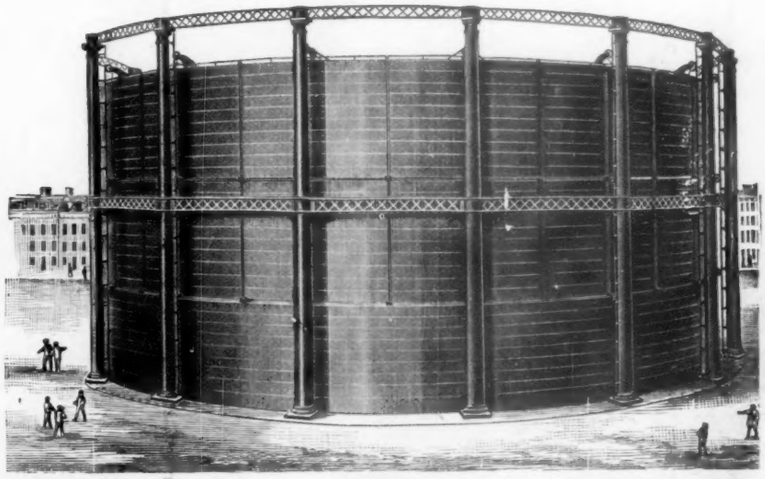
Triple Double, & Single-Lift
**GASHOLDERS.**

Iron Holder Tanks.

**ROOF FRAMES.**

**Cirders.**

BEAMS.



**PURIFIERS.**

CONDENSERS.

**Scrubbers.**

BENCH CASTINGS.

**OIL STORAGE TANKS.**

Boilers.

## The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

Munich Regenerative Furnace, System Drs. Schilling & Bunte.

**MILL'S REVERSIBEL LIME TRAYS.**

Gas Works Designed and Constructed.

---

Pascal Iron Works. ESTABLISHED 1821. Delaware Iron Works.

# MORRIS, TASKER & CO.,

INCORPORATED.

**OFFICE, 224 SOUTH THIRD STREET, - - PHILADELPHIA, PA.**

CONTRACTORS, BUILDERS, AND MANUFACTURERS OF

## Gas, Water & Sugar Works

Bench Castings.

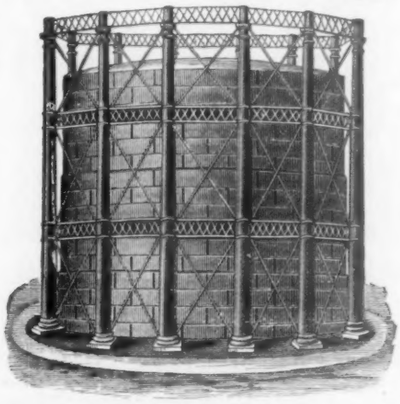
Condensers.

Scrubbers.

Purifiers.

Hyd. Carriages.

Iron Floors,



Iron Roofs.

Street Stops,

Valves, etc.

Stand-Pipes.

Water & Oil

Tanks, all Sizes.

## Single, Double, and Triple-Lift Gas Holders.

*SELF-SEALING RETORT LIDS. STAMPED STEEL RETORT LIDS.*

**Locomotive Water Columns, Filters, etc. Boiler Tubes, Wrought Iron Pipe & Fittings**

Plans, Specifications and Estimates for all kinds of Machinery furnished on application.

Foundries & Works, MILLVILLE, FLORENCE, and CAMDEN, N. J.

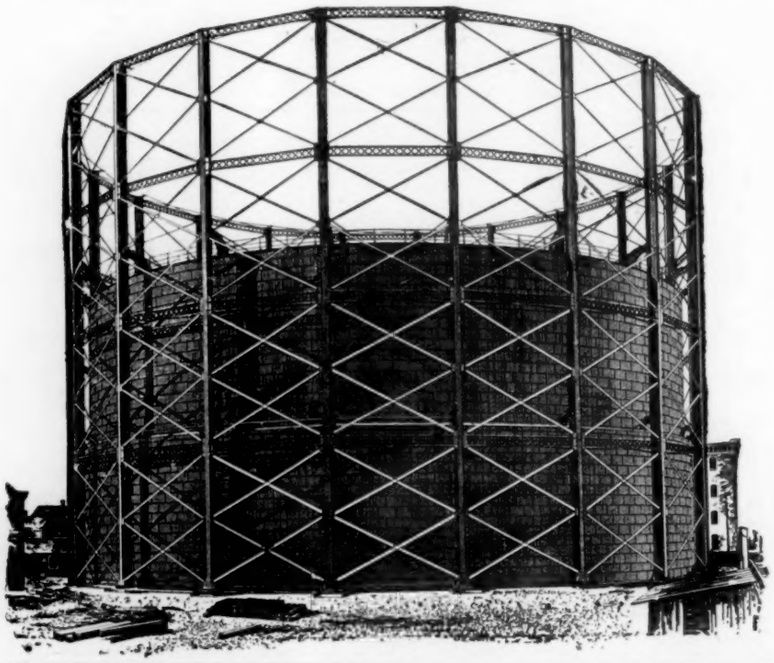
# R. D. WOOD & CO.,

Engineers, Iron Founders, and Machinists.

400 Chestnut St., PHILADELPHIA, PA.

MANUFACTURERS OF

# CAST IRON PIPE,



## Gas Holders,

SINGLE, DOUBLE, AND TRIPLE LIFTS, WITH OR WITHOUT WROUGHT IRON OR STEEL TANKS.

PURIFIERS, CONDENSERS.

Scrubbers.

BENCH WORK.

Iron Floors and Roofs, Plate Girders.

Heavy Loam Castings.

HYDRAULIC WORK.

Lamp Posts, Valves, Etc.

# ISBELL-PORTER COMPANY,

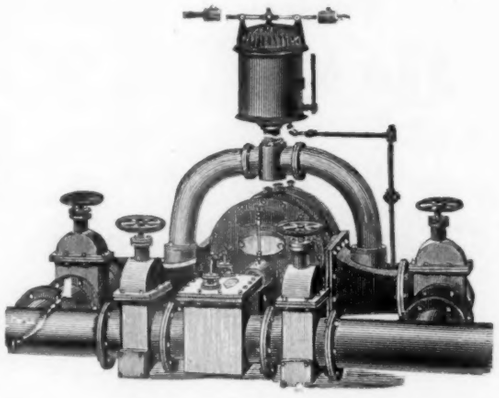
(Successors to SMITH & SAYRE MFG. COMPANY)

G. G. PORTER, Prest. *245 Broadway, N. Y.* CHAS. W. ISBELL, Sec'y.

## Machinery & Apparatus for Gas Works

**Drawings, Plans, and Estimates Furnished for the Improvement, Extension, or Alteration of Gas Works, or for the Construction of New Works.**

Mackenzie's Patent Rotary and Steam Jet Gas Exhausters, Governors, Compensators, Condensers, Washers, Scrubbers. Isbell's Patent Automatic Street Pressure Governor, Gas and Water Valves, Hydraulic Main Dip Regulator, Bench Castings, etc. Purifying Boxes and "Standard" Scrubbers Isbell's Patent Self-Sealing] Retort Doors



# THE BRENNER SELF-SEALING RETORT DOOR.

## Simple, Strong, and Durable.

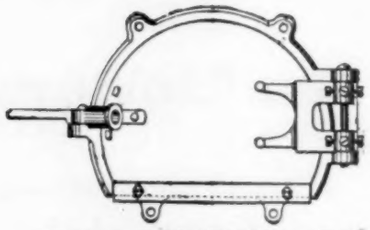
CLOSES ABSOLUTELY TIGHT & IS LOCKED BY A CAM LEVER. ALL NECESSARY ADJUSTMENT FOR WEAR PROVIDED.

BUILT BY

## ISBELL-PORTER COMPANY,

(Successors to Smith & Sayre Mfg. Co.)

**No. 245 Broadway, - - - - New York City.**



Brenner Self-Sealing Retort Door.

WILLIAM B. LUNDIE, Superintendent of the 42d Street Station of the Consolidated Gas Company, of New York, writes, under date of Jan. 4, 1889:

"We have 320 Brenner Self-Sealing Lids in use at this Station, built by the Smith & Sayre Mfg. Co. They require very little attention, and are the best of the kind that I have seen, giving entire satisfaction."

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.


# JAMES R. FLOYD & SONS,

(SUCCESSORS TO HERRING & FLOYD)

## Oregon Iron Works,

W. 20th & 21st. Sts., bet. 10th & 11th Avs.,

**NEW YORK CITY.**

Engineers and Contractors

FOR THE

## CONSTRUCTION OF GAS WORKS.

MANUFACTURERS OF

**All Kinds of Castings and General Ironwork**

FOR

**GAS APPARATUS.**

Bench Castings, Regenerative and Half Regenerative Furnace Castings.

**Condensers, Scrubbers, Purifiers, Street Drips and Connections,**

**Valves,**

**Hydraulic Hoisting Purifier Carriage, Self-Sealing Retort Lids, Improved Valve Stand and Indicator, Seller's Cement.**

Plans, Specifications, and Estimates furnished for Construction of New or Alteration of Old Works.

# Bouton Foundry Co.,

FOUNDERS AND MACHINISTS,

**CHICAGO, ILL.**

## Gas Works Apparatus,

**PURIFIERS, CONDENSERS,**

**Bench Work**

**SPECIALS, LAMP POSTS,**

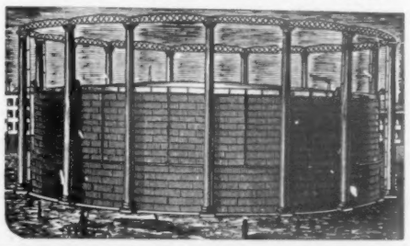
**SCRUBBERS,**

**Iron Roofs and Floors.**

Plans and Estimates furnished for new works or extensions of old works.

# CONTINENTAL IRON WORKS.

THOS. F. ROWLAND, Prest. WARREN E. HILL and CHAS. H. CORBETT, V-Prests. THOS. F. ROWLAND, JR., Sec. & Treas.



P. O. Station G., BROOKLYN, N. Y.

ENGINEERS AND MANUFACTURERS OF

## Gas Holders

**CONDENSERS, SCRUBBERS, VALVES,**

PURIFIERS, SELF-SEALING RETORT LIDS,

Hydraulic Mains,

**And all other articles connected with the manufacture and distribution of Gas.**

H. RANSHAW, Prest. & Mangr. WM. STACEY, Vice-Prest. T. H. BIRCH, Asst. Mangr. R. J. TARVIN, Sec. & Treas.

# STACEY MFG. CO.,

MANUFACTURERS OF

## Single and Telescopic Gasholders,

IRON ROOFS, BRIDGES, LAMP POSTS,

**Water and Oil Tanks, Coal Elevator Cars,**

**COKE CRUSHERS, BENCH CASTINGS,**

**And all kinds of Wrought and Cast Iron Work used in the erection of Coal and Oil Gas Works.**
Rolling Mill Machinery and Heavy Castings a Specialty.

**Foundry:**
**33, 35, 37 & 39 Mill Street.**

**Wrought Iron Works:**
**16, 18, 20, 22, 24 & 26 Ramsey Street:**

## Cincinnati, Ohio.

1842. # DEILY & FOWLER, 1891.

## Laurel Iron Works.

***Address, No. 39 Laurel Street, Philadelphia, Pa.***

BUILDERS OF

# GASHOLDERS,

Single and Telescopic.

**Holders Built 1885 to 1890, Inclusive:**

| | | | | |
|---|---|---|---|---|
| Omaha, Neb. | Port Chester, N. Y. | Paducah, Ky. | Tacony, Pa. (two) | Central Gas Lt. Co., New York City (3d) |
| Scranton, Pa. (2d) | New Rochelle, N. Y. | Norwich, Conn. | Mount Vernon, N. Y. | |
| Long Island City, N. Y. | Salem, N. J. (3d) | Seattle, W. T. | Binghamton, N. Y. | Tacoma, Wash. |
| Macon, Ga. | Omaha, Neb. (2d) | San Diego, Cal. | Concord, N. H. | Knoxville, Tenn. |
| York, Pa. | Lynn, Mass. (2d) | Northern Gas Lt. Co., of New York, N. Y. | Dover, Del. (3d) | Pottstown, Pa. |
| Chester, Pa. | Little Rock, Ark. | | Calais, Me. | Victoria, B. C. |
| Hazleton, Pa. (2d.) | Irvington, N. Y. | Westerly, R. I. | New London, Conn. (3d) | Vancouver, B. C. |
| Staten Island, N. Y. | South Boston, Mass. | Willimantic, Conn | West Chester, N. Y. | Charlottesville, Va. |
| Saugerties, N. Y. | Rye, N. Y. (2) | Montclair, N. J. | Bay Shore, L. I. | So. Framingham, Mass. |
| Clinton, Mass. (Lan. Mills) | Woodstock, Ont. | Attleboro, Mass. | Washington, D. C. | Woonsocket, R. I. |
| Chattanooga, Tenn. | Malden, Mass. | Santa Cruz, Cal. | Newport, R. I. (3d) | Simcoe, Can. |
| Galveston, Texas. (3d.) | Staten Island, N. Y. (2d) | Erie, Pa. (2d) | Morristown, N. J. | Pittsfield, Mass. (2d) |
| Fort Plain, N. Y. | Woodstock, Ont. | West Chester, Pa. (2d | Lebanon, Pa. | Chattanooga, Tenn. (2d) |
| Brunswick, Ga. | Malden, Mass. | Lancaster, Pa. (3d | Oakland, Cal. | |

# WM. HENRY WHITE,

## No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

# GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.

GAS COALS. CANNEL COALS. GAS ENRICHERS.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 & 229 Produce Exchange, New York.

Cable Address, "PERKINS, NEW YORK." Post Office Box 3695, New York.

GENERAL SALES AGENTS FOR

The Youghiogheny River Coal Company's

**OCEAN MINE YOUGHIOGHENY GAS-COAL.**

HON. W. L. SCOTT, Prest. M. H. TAYLOR, Vice-Prest.

This Colliery is located at SCOTT HAVEN, PA., in the center of the Youghiogheny Gas Coal District, and produces the ONLY RELIABLE YOUGHIOGHENY COAL for gas purposes. (See Map on p. 87 of this JOURNAL, Feb. 16, '85.)

POINTS OF SHIPMENT,

Locust Point, BALTIMORE. Pier No. 62, PHILADELPHIA.

Also, SOLE AGENTS for the

**BRECKENRIDGE CANNEL,**

OF KENTUCKY.

Within the past two years we have delivered this Cannel to over ONE HUNDRED COMPANIES IN THIRTY-THREE DIFFERENT STATES, and it is now in use in some of the large Gas Works

**On the Continent and in South America,**

where it successfully competes with the Australian Shale. It is the ONLY AMERICAN GAS CANNEL of sufficiently high grade to warrant EXPORTATION TO EUROPE AND SOUTH AMERICA, and it is the only economical substitute for OIL OR NAPHTHA. ONE GROSS TON will produce

10,000 Cubic Feet of 75 Candle Gas,
or 12,500 " " 60 " "
or 15,000 " " 50 " "
} equal to { 750,000 Candle Feet of Gas, and 26 Bushels of merchantable Coke weighing 900 Pounds

This is the ONLY GAS CANNEL that will produce a REALLY MERCHANTABLE COKE. It can be delivered in parcels of one carload or more to any point in the United States or Canada. Cargo shipments of any size required can be made from NEW YORK, PHILADELPHIA, BALTIMORE, or NEWPORT NEWS. Samples will be sent and particulars of price, etc., forwarded upon application to above address.

JAMES & WILLIAM WOOD,

**Gas and Cannel Coal Contractors,**

No. 40 St. Enoch Sq., Glasgow. No. 2 Talbot Court, London.

Proprietors of the BATHVILLE COLLIERIES (which produce the celebrated BOGHEAD CANNEL), Shields, Shieldmuir, Drumpeller, and other Collieries. This Firm offer

**STANDARD CANNELS,**

Unequaled as Gas Enrichers.

Analyses, prices, and all further information furnished on application to

**Agency for U.S., Room 70, Nos. 2 & 4 Stone St., N.Y. City.**

**The Standard Oil Company,**

REFINERS OF

**NAPTHA AND GASOLINES.**

ALSO MANUFACTURERS OF

A Special Grade of Naptha for Gas Companies

FOR ENRICHING COAL GAS.

Correspondence solicited.

No. 43 Euclid Avenue, Cleveland, Ohio.

**To Gas Companies.**

We make to order CAP BURNERS to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,

248 N 8th Street, Phila. Pa.

COKE CRUSHERS. GAS COALS. GAS COALS.


## The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

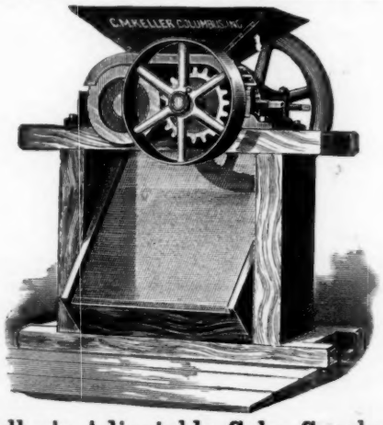
DESPARD GAS COAL,

AND MANUFACTURERS OF

**COKE.**

**MINES**, Clarksburg, Harrison Co., W. Va.
**WHARVES**, Locust Point, Baltimore, Md.
**OFFICE**, 44 South Street, Baltimore, Md

ROUSSEL & HICKS, 71 Broadway, N. Y. } *AGENTS.* { BANGS & HORTON, 60 Congress St., Boston




## Keller's Adjustable Coke Crusher.

**SIMPLE, STRONG, AND DURABLE.**

C. M. Keller, Sec. & Supt. Gas Lt. & Coke Co. Columbus, Ind.

**Correspondence Solicited.**

## GASOLINE and GAS ENGINES

Our new Engines are hustlers. A 6 x 7 inch Engine, now running 100 feet of shafting. Boring Mills, Planers, Lathes, Drill Presses and Milling Machines for 20 Machinists, on 6 gal. Gasoline per day, costing only 60 cts. Write for information. *Mention this paper.*

Van Duzen Gas & Gasoline Engine Co.
CINCINNATI, OHIO.

A. MacKinnon Machine Co., Agts., 22 Warren St., N.Y.

## King's Treatise on Coal Gas.

The most complete work on Coal Gas ever published.

**Three Vols. Bound, $30.**

## THE PENN GAS COAL CO.

OFFER THEIR

**Coal, Carefully Screened & Prepared for Gas Purposes.**

Their Property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

**209 SOUTH THIRD STREET, PHILA., PA.**

**Points of Shipment:**

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River: Pier No. 1 (Lower Side), South Amboy, N. J.

## Chesapeake & Ohio Railway Coal Agency,

FOR THE SALE OF THE

**Superior Kanawha Gas Coals, Cannelton Cannel,**

**Also, SPLINT AND STEAM COALS,**

From the Kanawha and New River Regions, on the line of the Chesapeake & Ohio R'way.

C. B. ORCUTT, General Agent, - - No. 1 Broadway (Room 217) New York City

FRANCIS H. JACKSON, Prest. EDMUND H. McCULLOUGH, V.-Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

## THE WESTMORELAND COAL CO.

Chartered 1854.

**Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Penn**

**POINTS OF SHIPMENT:**

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas giving qualities, and in freedom from sulphur and other impurities.

**Principal Office, 224 South 3d St., Phila., Pa.**

## THE CLERK GAS ENGINE CO.,

**Main Office, 1012, 1014, 1016, 1018 Filbert St., Philadelphia, Pa.**

WM. W. GOODWIN, Prest. E. STEIN, Sec.

The utility and convenience of the Gas Engine being no longer an open question, it only remains now for intending purchasers to select the BEST. We claim for the CLERK GAS ENGINE that it is equal to any other manufactured as regards steadiness in running, simplicity, and ease of keeping in repair, and that it gives the greatest amount of power for the least money (both in first cost and expense of running) of any engine made. In support of this claim we refer to the test of the Gas Engines made under the direction of the American Institute of New York, in December, 1885, and heretofore published in these columns. These engines are especially adapted for continuous running under heavy loads, and we can refer to Engines which have run 22 hours a day for months at a time

**Made in Sizes of 5, 10, 15 20, and 25 Horse Power. All Engines Guaranteed for One Year.**

# JOHN J. GRIFFIN & CO.,

Nos. 1513, 1515, 1517 & 1519 Race Street, PHILADELPHIA.
52 Dey St., NEW YORK. 75 N. Clinton St., (FRED. R. PERSONS, Mangr.) CHICAGO.

MANUFACTURERS OF

## METERS FOR MEASURING GAS

IN ANY VOLUME.

Provers, Gauges, Registers, Etc., Etc.

## EXPERIMENTAL APPARATUS FOR QUANTITATIVE AND QUALITATIVE ANALYSIS.

Careful and Prompt Attention paid to Repairing of all kinds of Meters and Apparatus.

**Estimates Cheerfully Furnished.**

**Dry Gas Meters.**

With 40 years' experience and the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

# NATHANIEL TUFTS,

*No. 153 Franklin Street, Boston, Mass.,*

MANUFACTURER OF

## DRY GAS METERS.

Station Meters of any Capacity.

**Test and Experimental Meters, Pressure Registers, Pressure Gauges, Pressure and Vacuum Gauges.**

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Patent Cluster Lanterns for Street Illumination.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

# THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

**BALTIMORE**, North & Saratoga Sts. **CHICAGO**, 197 Michigan Street.
**NEW YORK**, 838 Broadway. **SAN FRANCISCO**, 221 Front St.
**BOSTON**, 92 Water Street, Rooms 21 and 22.

## CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

## "Success" and "Perfect" Gas Stoves.

A. HARRIS. E. L. HARRIS. J. A. HARRIS.

**Established 1849.**

# HARRIS BROS. & CO.,

Twelfth and Brown Streets, Philadelphia.

## Manufacturers of Wet and Dry Gas Meters,

STATION METERS, METER PROVERS,

EXPERIMENTAL METERS, SHOW OR GLAZED METERS.

**Pressure and Vacuum Registers, Gauges, Photometers, Drip and Bell Pumps, Etc., Etc.**

PROMPT ATTENTION GIVEN TO ALL ORDERS. METERS THOROUGHLY REPAIRED. ESTIMATES FURNISHED FOR STATION METERS OF ALL SIZES. CORRESPONDENCE SOLICITED.

GAS METERS. GAS METERS. GAS METERS.

GEO. J. McGOURKEY, Prest. WM. H. McFADDEN, Vice-Prest. (Phila.) WM. N. MILSTED, Gen. Supt. and Treas. (New York). WM. H. DOWN, Sec.

# THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

**Manufactories:**
**512 West 22d St., N. Y.**
**Arch & 22d Sts., Phila.**

**GAS STOVES.**
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

**Agencies:**
177 Elm Street, Cincinnati.
244 & 246 N. Wells Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

## HELME & McILHENNY,

(Established 1848.)

# GAS METER MANUFACTURERS,

Nos. 1339 to 1349 Cherry Street, Philadelphia, Pa.,

**WET AND DRY GAS METERS. STATION METERS, EXPERIMENTAL METERS, METER PROVERS,**

Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works.

**FOULIS' PATENT STATION AND DISTRICT GOVERNORS.**

**REPAIRING DEPARTMENT.**—We employ a special force of skilled workmen repairing meters of **all makers.**

WM. WALLACE GOODWIN, President and Treasurer. E. STEIN, Vice-President. H. B. GOODWIN, Secretary and Superintendent.

# THE GOODWIN GAS STOVE AND METER CO.,

**Successors to W. W. GOODWIN & CO.**

1012, 1014 & 1016 Filbert St., Phila., Pa. 113 Chambers St., N. Y. City. 44 & 46 Dearborn St., Chicago, Ills.

WALDO BROTHERS, Agents, 88 Water Streets, Boston, Mass.

MANUFACTURERS OF

## DRY AND WET GAS METERS,

Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc. Meter Provers (sizes 2, 5, and 10 feet), Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6, and 9 inch), King's Pressure and Vacuum Gauges, Dry and Wet Center Seals, Dry and Wet Governors, Exhauster Governors, Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus complete. Also, Testing and Chemical Apparatus of all kinds, and of the most perfect description, for all purposes relating to Gas.

Manufacturers of the "SUN DIAL" GAS STOVES, for Cooking and Heating.

**Goodwin's Improved Lowe's Jet Photometer.** **Agents for Bray's Patent Gas Burners and Lanterns.**

Special attention to Repairs of Meters and all Apparatus connected with the business. All work guaranteed first-class in every particular. Orders filled promptly.

G. B. EDWARDS, Manager, New York. S. S. STRATTON, Manager, Chicago.

## D. McDONALD & CO.,

# GAS METER MANUFACTURERS.

(Established 1854.)

51 Lancaster St., Albany, N. Y. 34 & 36 West Monroe St., Chicago, Ill.

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

**Also STAR GAS STOVES, RANGES, and HEATING STOVES.**

We use only the very best materials, and employ the most skilled labor, and by our long experience (36 years) and personal supervision of every detail we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

# GAS INTO POWER,

BY THE

# OTTO GAS ENGINE.

**GAS POWER.—A Source of Revenue** to Gas Companies ready to engage in Electric Lighting, building of Water Works, Electric Street Railways, etc.

**Coal for producing Gas is less in amount** than that for producing Steam, both being measured on an equal amount of work performed. And, further, with Gas,

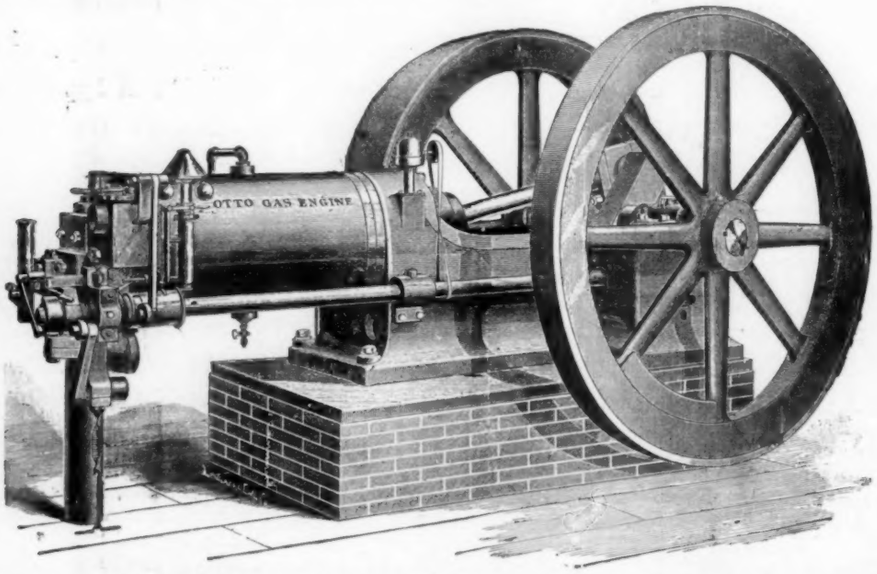
**50 to 90 per Cent. of Value of Coal is Returned**

by sale of Coke and Tar, according to the market value of these products.

**Labor** for handling fuel is **reduced,** by its becoming centralized and confined to the gas house and frequently has not increased after the addition of a power station.

With Gas Power, **cost of fuel** is strictly **limited** to the time of use.

MANY VALUABLE AND RECENT IMPROVEMENTS.




SIZES 1-3 to 100 HORSE POWER.

**Wherever Gas Companies tried Gas Power with Steam Power together in one Station, the use of Steam was subsequently abandoned or restricted, and Gas Power made to take its place.**

Where Gas Companies adopt Gas Power for Electric Plants, Water Works, Sewerage, etc., they not only choose **the most economical power for their use,** but secure to themselves the **numerous advantages of increased production,** without increase of expense, and benefit thereby their entire manufacture. They induce consumers, by their example, to abandon Steam for Gas Power, and, by establishing special rates, make

**Gas Power the Leading Power of To-Day,**

AND SOLVE AT ONCE THE QUESTION OF FUEL GAS.

# "Otto Gas Engine Works,"

SCHLEICHER, SCHUMM & CO.,

**151 Monroe St. (Kent Building), Chicago.** **33d & Walnut Sts., Phila.**

**NEW YORK AGENCY, 18 VESEY STREET.**